SCIENCE ABSTRACTS.

Section A.—PHYSICS.

OCTOBER, 1928.

GENERAL PHYSICS.

2540. Metre-Tonne-Second System of Units. C. E. Guillaume. *R.G.E.* 23. *pp.* 399–401, *March* 3, 1928.

The author cites evidence to show that the founders of the metric system intended the kilogramme to be the unit of mass and not the unit of weight. The impression that the latter was the case is attributed to lack of precision in scientific language. Historical notes are given concerning the metre-tonne-second system of units. Reference is also made to the " barye " as a unit of pressure and to the adoption of the " bar " as the international unit of pressure in meteorology. R. E. N.

2541. New Determination of the Ratio of the Imperial Standard Yard to the International Prototype Metre. J. E. Sears, Jr., W. H. Johnson and H. L. P. Jolly. *Roy. Soc., Phil. Trans.* 227. *pp.* 281–315, *May* 10, 1928.

The method employed for the determination of the ratio involves the use of a subsidiary line standard which is specially graduated in main intervals of 1⅛ in. The graduations define a number of approximate yard and metre lengths, 32 main intervals being closely equivalent to 1 yard and 35 to 1 metre. The relative values of the yard and metre lengths can be determined by a calibration of the main intervals, while their absolute values are determinable by comparison with the corresponding primary standards or attested copies. The paper describes how these determinations have been carried out and applied. They result in the following value of the ratio: 1 metre = 39·370147 in. AUTHORS.

2542. Contribution to the Development of Extension Instruments for Measuring Short Lengths. K. Böttcher. *Zeits. Instrumentenk.* 48. *pp.* 116–125, *March*; 178–187, *April*; 234–247, *May, and pp.* 285–292, *June*, 1928.

After a brief survey of known instruments for measuring short lengths, the author discusses a series of requirements which such instruments should possess. Since such apparatus is necessary for tension investigations in buildings and machines, a modification of the double-lever indicator instrument is thoroughly investigated and found to be more accurate than the Okhuizen apparatus, the average error being about $(20 - 25) \times 10^{-6}$ mm. Experiments are described whereby the efficiency of the new instrument is calibrated. The paper concludes with an example of an application to an endangered hook of rectangular cross-section by the Wyss measuring process. H. H. Ho.

2543. Simple and Certain Method for Discovering Leaks in Glass Vacuum Apparatus. P. Selényi. *Zeits. f. Phys.* 48. 9–10. *pp.* 733–734, 1928.

In its original form, which was employed in the manufacture of electric lamps, the bulbs were filled with CO_2, evacuated and caused to glow by means of Tesla currents. CO_2 gives a bluish-white glow, while that of air is red; the red colour appears at a leak, which can at once be marked. In testing vacuum apparatus it is often more convenient to have the air inside, and pass a current of CO_2 over the suspected portions of the exterior; the red-coloured glow changes to white at the leaks. H. N. A.

2544. Improved Quartz-Fibre Manometer. A. O. Beckman. *J.O.S.A. and R.S.I.* 16. *pp.* 276–278, *April,* 1928.

Trouble from room vibration in the use of a quartz-fibre gauge has been largely overcome by rigidly mounting it in a heavy metal block. The gauge is inserted in a hole in the metal block, a layer of asbestos packed at the bottom, the whole heated, and the space filled with molten solder, which is then allowed to cool. A telescope with a micrometer eyepiece for observing the amplitude of vibration is firmly attached to the same mounting. To facilitate setting the fibre in motion a magnetic starting device was made. The various arrangements are illustrated by sketches. T. B.

2545. Improved Glass Manometer. F. Daniels. *Am. Chem. Soc., J.* 50. *pp.* 1115–1118, *April,* 1928.

This is a device for measuring the pressure of a gas enclosed entirely in glass. A measured air pressure is balanced against the pressure of the enclosed gas through a glass diaphragm and the point of balance is obtained by closing an electrical circuit fused to the diaphragm. The apparatus is reliable and easy to construct. A. A. D.

2546. Improved Coordinator. R. A. Castleman, Jr. *J.O.S.A. and R.S.I.* 16. *pp.* 287–292, *April,* 1928.

A coordinator assembled from a T-square, a drawing-board, two slide rules and certain machined accessories has been developed as an improvement on the simple but useful device previously described [see Abstract 1726 (1923)]. The merits claimed for the present design are (*a*) compactness, simplicity in operation, accuracy, and (*b*) ease of assembly from apparatus readily and cheaply available. AUTHOR.

2547. Laboratory Curve Tracer. *Journ. Sci. Instruments,* 5. *pp.* 167–170, *May,* 1928.

An instrument, due to Brearley and manufactured by the Cambridge Instrument Co., is described in which scale deflections of any mirror instrument are plotted upon a chart wound upon a drum. Its application to various types of cooling curves is shown. The advantages of such a method over intermittent registration of similar values where errors may arise are illustrated. B.-J. L.

2548. Novelties in Meteorological Instruments. O. Devik. *Zeits. f. Instrumentenk.* 48. *pp.* 218–228, *May,* 1928.

Describes new departures in the construction of various types of instruments. The first is an anemometer for the distant registration of both the speed and the direction of the wind, using only a three-wire circuit. This instrument is described in full and illustrated with diagrams. The next two instruments described are respectively for determining the speed and direction of motion of the clouds. Finally, a description is given of a hair hygrometer with micrometer measurement of the change of length and with temperature compensation. J. W. T. W.

2549. Application of an Electromagnetic Force to the Thermo-Balance. Z. Shibata and M. Fukushima. *Chem. Soc. Japan, Bull.* 3. *pp.* 118–123, *May*, 1928.

Honda's thermo-balance [Abstract 1 (1916)] exhibits the following defects: (1) By magnifying the sensitiveness of the balance, the movements on its scale are multiplied even by a small change of weight, and it becomes necessary to interrupt the measurement and change the weight on the beam of the balance during an experiment; (2) the upward and downward movements of the arms of the balance cause the spring to stretch and contract, the hysteresis of the spring causing error; (3) the thermocouple cannot be fixed with the sample, so that when the position of the latter is displaced by the change in its weight, it recedes from the former and the exact reacting temperature is not observable by the thermocouple. These defects may be removed by fitting an electromagnet to one side of the beam of the balance. The current is adjusted in the observing position so that the scale is always set at the zero point. The change in the weight of the same can be found indirectly from the amount of the current, the sensitiveness can be increased, and the temperature of the reaction can be found exactly. The efficiency of the arrangement is shown by the results obtained in determinations of the decomposition curves of calcium carbonate, copper sulphate, cadmium sulphate, barium chloride, and ferrous ammonium sulphate. T. H. P.

2550. New Equilibrator. G. Jones and B. B. Kaplan. *Am. Chem. Soc., J.* 50. *pp.* 1600–1603, *June*, 1928.

A closed glass apparatus, without valves or seals, except those produced by the two separated solutions which are being studied. The two tubes containing the liquids, which are inclined to one another, are connected at the ends by smaller tubes in such a way that the liquids cannot pass from one vessel to the other when the apparatus is working. The whole is mounted on a shaft inclined to the vertical at 11°, by means of which it is rotated, the result being that the gas or vapour is circulated round the tubes and bubbles through the two liquids. After equilibrium has been established, the vapour pressure of the common volatile constituent of the two liquids is the same in both vessels, and the liquids can be removed for analysis. The distribution of iodine between H_2O and a solution of potassium iodide has been studied. H. N. A.

2551. Capillary Action of Mercury on the Absence of "Gas-Grown" Skins. J. J. Manley. *Phil. Mag.* 5. *pp.* 958–962, *May*, 1928. *Supplement.*

Observations relating to the surface of a mercury column in a barometric tube. Methods are described for destroying the "gas-grown" skin on the surface of the mercury in contact with gas in the tube. This barrier skin or film is initially responsible for the usual capillary depression of mercury. In general, other liquids instantly dissolve the skin and so come into intimate contact with the glass and wet it, hence the familiar capillary elevation. A. B. W.

2552. Colloidal Theory of Surface Tension. S. Ray. *Kolloid Zeits.* 45. *pp.* 9–12, *May,* 1928.

According to the theory expounded in this paper, the rise of a liquid in a capillary tube corresponds to an upward-directed force acting on the raised column. This force is ascribed to the electrical attraction between the charged gas molecules above upon the charged liquid molecules below, both being caused by the absorption process of gases and the evaporation process of the liquid to go reciprocally into stable solution. A mechanism is suggested for capillary rise and fall and for the capillary electrometer. H. H. Ho.

2553. Surface Tension of Mixtures of Ethyl Alcohol and Water. Part I. K. I. Alekseewa. *Zeits. f. phys. Chem.* 134. 5–6. *pp.* 467–474, *June,* 1928.

In determining the refraction of electromagnetic waves in liquids, Colley [see Abstract 2096 (1907)] observed discontinuities in the curves of alcohol-water mixtures. The author determines the surface tension of such mixtures within the range 99·7 to 87 % of alcohol, decreasing the alcohol concentration in steps of about 0·1 %, by the method of Cantor. A capillary is dipped into the liquid, and the pressure of the last of a series of air bubbles escaping from the capillary is measured. The pressures are found to vary, within the limits of experimental errors, regularly with the concentration. Measurements were made at alcohol temperatures of 23·8° and air temperatures of about 26°. H. B.

2554. Some Physical Properties of Aqueous Hydroxybenzene Solutions. L. E. Swearingen. *J. Phys. Chem.* 32. *pp.* 785–793, *May,* 1928.

The density, viscosity, index of refraction and surface tension of aqueous solutions of hydrobenzenes were determined at 25° C. The hydroxyl group has no pronounced effect on the properties determined, except on the surface tension. The number and position of the hydroxyl groups affected only the surface tension to any pronounced extent. The monohydric derivative was found to be more effective than the dihydric derivative, which in turn was more effective than the trihydric derivative in lowering the surface tension of water. F. J. B.

2555. Effect of Temperature on the Viscosity of Neon. R. S. Edwards. *Roy. Soc., Proc.* 119. *pp.* 578–590, *July* 4, 1928.

The ratios of the viscosities of neon at various temperatures between – 78·4° and 444·5° C. have been determined, using a constant-volume method [see also Abstract 528 (1928)] and suitable jackets to obtain definite temperatures. The actual values of the viscosity in terms of a standard air value have also been determined, and their representation by the theoretical formulæ of Lennard-Jones and Sutherland is discussed. H. H. Ho.

2556. Bubbles, Drops and Stokes Law. W. N. Bond and D. A. Newton. *Phil. Mag.* 5. *pp.* 794–800, *April,* 1928.

In a previous paper [see Abstract 524 (1928)] it was shown that drops or bubbles in a more viscous medium might have a terminal velocity of one and a half times that of a solid sphere. The present paper shows experimentally and theoretically that surface tension of the drop or bubble decreases the terminal velocity. For radii less than a critical value the drop behaves as a rigid sphere. After a fairly rapid transition through the critical point the effect of surface tension becomes small. F. S.

2557. Terminal Velocity of Drops. W. D. Flower. *Phys. Soc., Proc.* 40. *pp.* 167–175; *Disc.*, 175–176, *June*, 1928.

To determine the distance of fall for a constant terminal velocity a drop of measured volume was liberated from a point vertically above the pan of a torsion balance, the path being increased until constant momentum was acquired. Results are given for drops with volumes 0·2 to 0·7 c.c. for water, and 0·15 to 0·65 c.c. for methyl salicylate and a relation connecting the distance of fall and the volume of the drop obtained. The constant terminal velocities for each liquid over the given range of volumes were found by a photographic method, a number of drops of uniform size falling just in front of a highly and evenly illuminated vertical ground-glass slit and being photographed by means of an ultra-rapid cinema camera. A relation connecting the terminal velocity of a drop and its volume has been obtained. In the *Discussion*, **W. N. Bond** mentioned certain results regarding the critical sizes of drops, while **R. G. Lunnon** dealt with the oscillations of the drops and also asked how the satellite drops were measured and how large they were. The author replied. R. S. R.

2558. Equilibrium of a Fluid Mass. R. Wavre. *Comptes Rendus*, 186. *pp.* 734–736, *March* 19, 1928.

If ϵ be the gravitation constant and the other symbols have their usual significance, the quantity f is defined by $f = -4\pi\epsilon\rho + 2\omega^2$. Then if $D\sigma$ be an element of surface area it is shown that

$$\frac{f}{g} = \frac{1}{2}\,\frac{\dfrac{d}{d\theta}\left[\dfrac{d}{dt}\left(\mathrm{L}\dfrac{D\sigma}{dn}\right)\right]}{\dfrac{d}{d\theta}\left(\dfrac{dn}{dt}\right)}.$$

A. Wh.

2559. Oscillatory Motion of a Viscous Liquid in a Long Straight Tube. S. F. Grace. *Phil. Mag.* 5. *pp.* 933–939, *May*, 1928. *Supplement.*

The present paper draws attention to the difference in the velocity-distribution in the case of the oscillatory motion of a viscous liquid as compared with that which occurs when the liquid is in steady motion, and raises the question as to what form the Osborne Reynolds' criterion will take for oscillatory motion. The great difference in velocity distribution produced by oscillation suggests the advisability of an examination of this criterion in the case of oscillatory motion from both theoretical and experimental viewpoints. H. H. Ho.

2560. Maxwell Relaxation Law and Inner Friction of Liquids. A. Predwoditelew. *Zeits. f. Phys.* 49. 3–4. *pp.* 279–294, 1928.

In this paper the author investigates the shape which the hydrodynamic equations of a viscous fluid take when founded upon Hooke's law as generalised by Maxwell. The geometrical and physical aspects are sharply separated by the derivation of these equations. A valid mechanism is then described which appears to produce longitudinal, rapidly damped micro-waves, the necessity for which has been shown in specific heat investigations. It is assumed that these acoustic micro-oscillations in a fluid obey the Maxwell hydrodynamics. By means of the method of identical conditions (Christoffel, Hugoniot, Riemann) the spreading velocity of the longitudinal oscillations is calculated and the connection given between this velocity and the inner friction of liquids. **Errata,** *ibid.*, 49. 11–12. p. 893, 1928. H. H. Ho.

2561. Principles of Semi-Fluid Friction. S. Kiesskalt. *Zeits. f. tech. Phys.* 9. 6. *pp.* 207–212, 1928.

After a thorough discussion of the literature (old and new) relating to the lubrication value, hypotheses are developed with respect to the molecular physical phenomena concerned. It is found that the different behaviour of oils of equal lubrication value (from the analytical data) has nothing to do with the surface tension towards air but is related to the varying adsorption at metallic surfaces and the dependence of viscosity on pressure. The processes take place in the boundary phase. The technical importance of these results is emphasised. H. H. Ho.

2562. Dynamical Method for the Determination of Young's Modulus by Stretching. C. F. Sharman. *Cambridge Phil. Soc., Proc.* 24. *pp.* 276–279, *April*, 1928.

A new method in which two wires each about 80 cm. long are stretched between a vibrating bar and a heavy fixed brass bar. J. J. S.

2563. Equations of Small Movements of Elastic Surfaces. L. Roy. *Comptes Rendus*, 186. *pp.* 1397–1399, *May* 21, 1928.

In this mathematical paper the equations of the small movements of an elastic surface about a position of stable equilibrium are deduced from general equations. The case of the surface with three parameters [see Abstract 2042 (1928)] is taken as an example, various simplifications being introduced for special cases. H. H. Ho.

2564. Calculation of Certain Elastic Deformations with Application to the Inertia of Spirals. J. Haag. *Comptes Rendus*, 186. *pp.* 1421–1423, *May* 21, 1928.

Continues the preceding note [see Abstract 2040 (1928)] by calculating the effect of the inertia of the spiral upon the period of vibration.

W. G. B.

2565. Elastic Equilibrium of a Rectangular Prism. Belzecki. *Comptes Rendus*, 186. *pp.* 1461–1462, *May* 30, 1928.

The most general solution is expressible in terms of the solutions of three " plane " problems. W. G. B.

2566. A Rayleigh Wave Problem. R. Stoneley. *Leeds Philosoph. and Lit. Soc., Proc.* 1. *pp.* 217–225, *April*, 1928.

The propagation of surface waves is investigated for a layer of uniform elastic material, with one plane face free and the other parallel face fixed.

This is equivalent to examining the effect of a finite depth of the medium on the velocity of Rayleigh waves. It is found that the velocity depends on the wave-length, and that waves may be transmitted with any velocity greater than that of simple Rayleigh waves. The geophysical interest of the investigation lies in its relation to the problem of Rayleigh waves in a superficial layer, of which this is a limiting case. AUTHOR.

2567. Theory of Rayleigh's Principle Applied to Continuous Systems. G. Temple. *Roy. Soc., Proc.* 119. *pp.* 276–293, *June* 1, 1928.

The object of this paper is to examine and extend a method frequently applied by Rayleigh to the calculation of the frequency of the gravest mode of a vibrating system. Since almost any differentiable function satisfying the boundary conditions of the problem may be made the basis of a calculation yielding a close approximation to the fundamental frequency, a method has now been devised for obtaining an upper limit to the error involved. Rayleigh's method is also extended to the calculation of the frequency of the first overtone, and analogous methods are given for more general problems of the computation of " characteristic numbers."

H. H. Ho.

2568. Longitudinal Wave Along a Rod. S. Ray. *Phys. Soc., Proc.* 40. *p.* 177, *June,* 1928.

That longitudinal waves are propagated with the same velocity for all wave-lengths only when the waves are " geometrically similar " is here proved in exactly the same manner as for either strings, air columns or transverse waves along stretched strings. The expression for the velocity is, of course, different. AUTHOR.

2569. Experiments with Mercury Jets and the Phenomena Exhibited at their Impact with Steel and Glass. W. C. Baker. *Phys. Soc., Proc.* 40. *pp.* 181–185; *Disc.,* 185, *June,* 1928.

As a light sphere is retained in a vertical jet of fluid in virtue of the change of momentum of the fluid produced by its adhesion to the sphere, it was thought that a steel sphere would not be retained in a vertical mercury jet, as there is no " wetting " of the steel by that fluid. Experiment showed that a given bicycle ball might or might not be retained by such a jet, as the speed of the jet (at a given angle of incidence) rose above or fell below a critical value for that ball. Conditions were simplified by the use of cylindrical and of plane surfaces of steel, and an approximately constant time of adhesion between mercury and steel was found for various speeds of impact. This led to the explanation of the phenomenon in terms of the well-known instability of jets. AUTHOR.

2570. Compression-Resistance of Rubber. R. Ariano. *N. Cimento,* 5. *pp.* 77–107, *March,* 1928.

Investigates the compression curves, Poisson's coefficient and the work of deformation for vulcanised rubber. The compression curves are hyperbolæ or straight lines according to whether the loads are referred to the initial sections or to the actual sections. Comparing these curves with the traction curves, there is a singular point at the origin of coordinates (undeformed state). Poisson's coefficient was measured through a considerable range; it is shown to vary from 0·5 to ∞. For the work of compression the expressions obtained are logarithmic. Non-vulcanised rubber shows a " fluidification load." A. D.

2571. Further Study of Elastic Behaviour of India-Rubber. G. B. Deodhar and D. S. Kothari. *Indian Journ. Phys.* 2. *pp.* 305–318, *March*, 1928.

In the earlier paper [see Abstract 1286 (1923)] the remarkable effects of varying the load on the coefficient of Young's modulus and Poisson's ratio are given. In the present paper the coefficient of rigidity of india-rubber for gradually increasing loads up to the breaking point is experimentally studied. Three samples are used: (1) A rod fashioned out of thick pressure tubing, (2) a thicker rubber rod, (3) a thin rubber rod of the same quality as (2). It is found that the rigidity increases linearly with stress up to the breaking point for the three samples. The qualitative effects of heat treatment on the modulus is determined. From the rigidity values obtained it is inferred that india-rubber behaves similarly to many other substances, such as the metals. J. K.

2572. Lamellar Packing of India-Rubber. M. Kröger. *Kolloid Zeits.* 45. *pp.* 46–52, *May*, 1928.

It is shown that the absorption of energy by the transition to a lamellar packing is different to that produced by a change to a rod-shaped packing. J. K.

2573. Double Refraction of India-Rubber in the Normal and Deformed Conditions. M. Kröger. *Kolloid Zeits.* 45. *pp.* 52–56, *May*, 1928.

It is shown that rubber on lengthening becomes doubly refractive and that longitudinal extension leads to single or biaxial, positive, double refraction. In lamellar deformation in all cases weak, biaxial, negative, double refraction occurs. J. K.

2574. Thermic and Calorimetric Values of India-Rubber and the Rubber-Like Substances. M. le Blanc and M. Kröger. *Zeits. f. Elektrochem.* 34. *pp.* 241–244, *May*, 1928.

In the main a mathematical paper where, in particular, the variations in the elastic properties of india-rubber and analogous rubber-like substances over a wide range of temperature is considered upon thermodynamic grounds. The experimental values obtained in the specific-heat determinations for rubber, stretched and unstretched, vulcanised and unvulcanised are given for temperatures lying between − 165° C. and + 41·4° C. J. K.

2575. Structure Investigation for Stretched Synthetic Rubber. L. Hock and W. Barth. *Zeits. f. phys. Chem.* 134. 3–4. *pp.* 271–278, *June*, 1928.

The authors pass in review the work done in this field for rubber. It is pointed out that so long as rubber is unstretched it has all the typical characteristics of an amorphous substance, this no longer being so, however, for stretched rubber. According to the present research on stretched synthetic rubber, Röntgen interference bands can only be obtained, and even then they are not too distinct at low temperatures. J. K.

2576. Elastic Constants of Glass. E. P. Perman and W. D. Urry. *Phys. Soc., Proc.* 40. *pp.* 186–192; *Disc.*, 192, *June*, 1928.

(1) The coefficients of compressibility of soda-glass and Jena 16^{III} glass have been determined at six temperatures ranging from 30° C. to 80° C. (2) From experiments on the effect of external pressure only, Poisson's ratio has been determined, and hence the modulus of rigidity and Young's modulus. AUTHORS.

2577. Rectangular Plate subjected to Normal Pressure. A. Mesnager. *Comptes Rendus*, 186. *pp.* 1321–1323, *May* 14, *and pp.* 1472–1474, *June* 4, 1928.

Builds up a solution from trigonometric series; the second paper modifies the procedure. W. G. B.

2578. Thick Circular and Rectangular Plates Loaded at the Centre. C. A. Garabedian. *Comptes Rendus*, 186. *pp.* 1518–1520, *June* 4, 1928.

The author has previously published the solutions of eight problems relating to the bending of thick plates, supported freely or rigidly fixed at their circular or rectangular edges, and carrying a load either uniformly distributed or concentrated at the centre. Four of these solutions, however, which relate to central loads, which were based on views first advanced by de Saint-Venant, have been found to be erroneous, and the correct solutions are given in the present paper. H. N. A.

2579. Trigonometrical Stability. G. Vranceanu. *Accad. Lincei, Atti*, 6. *pp.* 474–480, *Dec.* 4, 1927.

A mathematical investigation and extension of a property shown by Poincaré to apply to conservative dynamical systems. A. Wh.

2580. Solution of a System of Non-Homogeneous Linear Differential Equations in Dynamics. Y. Hagihara. *Phys. Math. Soc. Japan, Proc.* 10. *pp.* 61–70, *April*, 1928. *In English.*

In this paper the solution of the system of non-homogeneous differential equations is obtained by the method of matrices and the result established that the characteristic exponents determined by the system of homogeneous linear differential equations are not affected by the presence of the non-homogeneous terms. Hence to establish the stability or otherwise of a dynamical system whose variational solution is represented by a system of non-homogeneous differential equations, it is sufficient to treat the system of homogeneous equations only. H. H. Ho.

2581. Contribution to the Theory of Quaternions. E. Göllnitz. *Akad. Wiss. Wien, Ber.* 137. 2*a*. *No.* 3–4. *pp.* 157–188, 1928.

2582. Certain Tensors in Non-Holonomous Variables. G. Vranceanu. *Comptes Rendus*, 186. *pp.* 995–997, *April* 11, 1928.

This mathematical investigation continues previous work [see Abstracts 542 and 867 (1927)] in which the author has sought to apply the absolute differential calculus to the study of non-holonomous variables. If displacements in V_n^m are given by $dx_i = \sum_1^m {}_h \lambda_h^i ds_h$ $(i = 1, 2, \ldots, n)$, *i.e.*, where the dx_i's are connected by the $n - m$, Pfaff forms $\sum_1^n {}_i \lambda_{h'|i} dx_i = 0$,

($k' = m + 1, \ldots, n$), where $a\lambda$ ($a = 1, 2 \ldots, n$) are n orthogonal congruences in V_n, then the conditions of integration are expressed by $w_{hl}^{k'} = V_{k'hl} - V_{k'lh} = 0$ ($k' = m + 1, \ldots, n$); ($h, l = 1, 2 \ldots, m$), where $V_{k'hl}$ are the Ricci rotation coefficients relative to the congruences λ. If $w_{hl}^{k'}$'s are not all zero, $n - m$ tensors of the second order result, and from the invariant character of the equations towards the variations of a geodesic in V_n^m, $n - m$ tensors of the third order are derived. These tensors are further discussed in the paper. H. H. Ho.

2583. Calculation of Kinetostatic Undetermined Systems. R. Girtler. *Akad. Wiss. Wien, Ber.* 137. 2*a*. 1–2. *pp*. 51–69, 1928.

In this paper it is shown that a solid isotropic elastic system of movable bodies corresponding to given conditions, which when rigid is kinetostatically undetermined, may be evaluated when the work of deviation from the equilibrium state is assumed to be a function of the strain components and is considered a minimum. This is an extension of Castigliano's principle on the minimum of work during change of form referred to static cases. The principle is then applied to parts of the system, to the case where the work of deviation is a function of external forces, to displacement accelerations, and to the determination of kinetostatically undetermined quantities when the inertia forces due to elastic motion may be neglected. H. H. Ho.

2584. Relations between Riemann Potentials and Quadratic Differential Forms of Stationary Fields with Symmetrical Symmetry. P. Swings. *Comptes Rendus,* 186. *pp*. 1520–1522, *June* 4, 1928.

Gives a number of mathematical relations governing the motion of a body in a plane orbit in a stationary field with symmetrical symmetry. H. N. A.

2585. Ricci Coefficients. V. Hlavatý. *Comptes Rendus,* 186. *pp*. 1691–1694, *June* 18, 1928.

In a Riemann variable V_m assume n orthogonal congruences linearly independent, and let $e_k^v = \frac{dx^v}{ds_k}$ ($k = 1, \ldots, n$) be the unitary vector tangent of the kth congruence. The connection of V_n may be defined by means of the Ricci coefficients $\gamma_{hik} = -\gamma_{ihk}$, relative to the congruences mentioned $\delta\epsilon_{ih}^v = ds_i \sum_1^n {}_k \gamma_{hki} e_k^v$ ($i, h = 1, \ldots, n$), where δ_i denotes the symbol of the differential covariant of V_n in the direction of e_i^v. In this paper the author gives a geometrical interpretation of γ_{hki} for $n = 3$ by utilising the notion of the non-holonomous variable V_3^2 developed by Vranceanu [see Asbtracts 542 and 867 (1927)] and Schouten. Application is then made to a non-holonomous variable of $n - 1$ dimensions V_n^{n-1} in V_n. H. H. Ho.

2586. Theory of Internal Ballistics. C. A. Clemmow. *Roy. Soc., Phil. Trans.* 227. *pp*. 345–382, *June* 11, 1928.

This paper, which is entirely theoretical, deals with the theory of internal ballistics, based on a pressure-index law of burning of propellants. Only the ideal case with no frictional resistance is considered, and the treatment consists mainly of a discussion of the fundamental equations of the subject and their solution. This paper should be consulted in the original. R. C. F.

2587. Method of Calculation Suitable in Certain Physical Problems. T. J. I'a Bromwich. *Phil. Mag.* 6. *pp.* 98–99, *July*, 1928.

In certain physical problems where pairs of quantities are connected by a relation of the type $y = Ax^n$, it is usual in numerical work to reduce this to the logarithmic form. When, however, the conditions are such that x and y do not differ greatly from certain standard values x_0 and y_0, a more accurate (as well as a more rapid) method now described is to calculate the value of the difference $y - y_0$ in terms of $(x - x_0)$, *viz.*, $y - y_0 = k(x - x_0)\{1 - (x - x_0)/x_1\}$, where $k = ny_0/x_0$ and $x_1 = 2x_0/(1 - n)$, these values being independent of x and y. Application is made to the " adjustment " of cordite charges. H. H. Ho.

2588. Polar and Axial Vectors in Physics. J. v. Weyssenhoff. *Zeits. f. Phys.* 48. 11–12. *pp.* 882–887, 1928.

It is shown how, by means of a simple mental picture, polar and axial vectors in physics may be distinguished without recourse to coordinates, vector components, reflections, etc. The division of all physical vector quantities into axial and polar can in this way be effected, although on practical grounds the distinction between the two is suppressed in the vector calculus. W. S. S.

2589. Study of Non-Fluorated Micas by Means of X-Rays. C. Mauguin. *Comptes Rendus*, 186. *pp.* 879–881, *March* 26, 1928.

The variations in the composition of micas are probably to be explained, not chemically but crystallographically. With this idea in mind various micas have been studied to determine unit cells by X-rays. The micas are formed in layers 10 Å. thick. Each layer is formed by the repetition of a lozenge-shaped cell whose diagonals *ab* are in the ratio $1 : \sqrt{3}$. Each layer repeats the next by translation normal to *b* and 100° with *a*. The unit cell is thus a clinorhombic prism. Muscovite and margarite are exceptional. The layers are in pairs. Succeeding planes suffer a translation plus a mirror reflection in plane 010 (symmetry plane of translation). In biotite, to obtain a cell analogous to the others one must take three apparent cells in the *b* direction. A table is given showing parameters and numbers of each kind of atom per unit cell in five means. There are always 12 atoms of O. The numbers of other atoms is variable, indicating that the unit cells are not identical and that experiment gives only the mean size. It appears probable that the 12 oxygen atoms form the ground structure and that the other atoms fit in the spaces between them. J. E.

2590. Study of Fluorated Micas by Means of X-Rays. C. Mauguin and L. Graber. *Comptes Rendus*, 186. *pp.* 1131–1133, *April* 23, 1928.

The unit cell of non-fluorated micas contains 12 atoms [see preceding Abstract]. This rule is not true for fluorated micas. The number of O + F, however, is again 12, but the proportion of O to F varies from layer to layer. One may say that OH may be replaced by F, which is not surprising, since they are of nearly the same size. J. E.

2591. Crystal Structure of Thio-Urea. L. Demény and I. Nitta.

Chem. Soc. Japan, Bull. 3. *pp.* 128–136, *May,* 1928.

From Laue photographs and ionisation spectrometer readings it is deduced that thio-urea has an orthorhombic unit cell of edges 5·47, 7·64 and 8·54 Å., containing four molecules of CSN_2H_4. Density 1·408. Cleavage plane is *b*(010). The probable space-group is V_h^{16} and the proposed structure, neglecting H atoms, is:—

$$4\,C\{u, v, 0;\ \ -u, \tfrac{1}{2}-v, \tfrac{1}{2};\ \ \tfrac{1}{2}-u, \tfrac{1}{2}+v, 0;\ \ \tfrac{1}{2}+u, -v, \tfrac{1}{2}\}$$

with $u = 0\cdot186$, $v = 0\cdot144$;

$$4\,S\{u, v, 0;\ \ -u, \tfrac{1}{2}-v, \tfrac{1}{2};\ \ \tfrac{1}{2}-u, \tfrac{1}{2}+v, 0;\ \ \tfrac{1}{2}+u, -v, \tfrac{1}{2}\}$$

with $u = -\,0\cdot095$, $v = 0\cdot270$; and

$$8\,N\left\{\begin{matrix} x, y, z;\ -x, \tfrac{1}{2}-y, \tfrac{1}{2}+z;\ \tfrac{1}{2}-x, \tfrac{1}{2}+y, -z;\ \tfrac{1}{2}+x, -y, \tfrac{1}{2}-z; \\ -x, \tfrac{1}{2}-y, \tfrac{1}{2}-z;\ x, y, -z;\ \tfrac{1}{2}+x, -y, \tfrac{1}{2}+z;\ \tfrac{1}{2}-x, \tfrac{1}{2}+y, z \end{matrix}\right\}$$

with $x = 0\cdot300$, $y = 0\cdot164$ and $z = 0\cdot144$. The molecule has a plane of symmetry. In the proposed structure the distance C — S is 1·81 Å. and C — N is 1·39 Å. It is possible to derive the crystal structure of urea from that of thio-urea by making every molecule flat in the *zx*-plane and giving it a small amount of translation and a rotation through $\pi/4$ about the axis C — S. W. H. GE.

2592. Crystal Structure of α-Manganese. G. D. Preston.

Phil. Mag. 5. *pp.* 1198–1206, *June,* 1928.

Laue photographs show α-manganese to be cubic and oscillation photographs show a body-centred lattice. The side of the unit cube containing 58 atoms was found from a powder photograph to be 8·894 ± 0·002 Å. An accurate determination of the density, by displacement of CCl_4, gave a value not less than 7·44 gm./cm.^{3}. Assuming that the "diameter" of the manganese atom is not less than 2 Å., T_d^3 is the only space-group for which a satisfactory account of the intensities of reflection observed in the oscillation photographs was obtained.

W. H. GE.

2593. Crystal Structure of SnS_2, TiS_2, $TiSe_2$ and $TiTe_2$. I. Oftedal.

Zeits. f. phys. Chem. 134. 3–4. *pp.* 301–310, *June,* 1928.

Powder photographs gave the following results for the dimensions in Å. of the unit cells :—

Compound.	*c*.	*a*.
SnS_2	5·868 ± 0·009	3·639 ± 0·003
TiS_2	5·691 ± 0·010	3·397 ± 0·003
$TiSe_2$	5·995 ± 0·010	3·533 ± 0·003
$TiTe_2$	6·539 ± 0·010	3·774 ± 0·003

The positions and intensities of the lines can be satisfactorily accounted for by ascribing a CdI_2 structure to the compounds. W. H. GE.

2594. Crystallography and Optical Properties of β-lactose. E. T. Wherry. *Washington Acad. Sci., J.* 18. *pp.* 302–304, *June* 18, 1928.

The author describes a method of identification of crystals of β-lactose by the immersion method under the polarising microscope. The method of preparation and identification of the specimen examined is given. The crystals are transparent, colourless, and belong to the holo-axial-polar (sphenoidal) class. A table showing the optical constants of the three sugars is appended. The refractive indices of β-lactose are much higher than those of α-lactose, the former being anhydrous. Immersion liquids of refractive indices 1·520, 1·540, 1·555, 1·570 and 1·585 are used. By the method employed the eye is able to distinguish differences in refractive index between the two substances in contact of less than 0·003. Full details of the identification test are given. If the liquid of refractive index 1·585 matches the highest refractive index of any of the grains β-lactose is indicated. Sucrose and α-lactose can also be similarly identified with liquids of the given refractive indices, as shown in the instructions appended. S. G. B.

2595. Atomic Arrangement in the Crystal of Orthorhombic Iodine. P. M. Harris. E. Mack, Jr., and F. C. Blake. *Am. Chem. Soc., J.* 50. *pp.* 1583–1600, *June*, 1928.

Laue, powder method, and oscillated crystal X-ray photographs have been made with the ordinary form of solid iodine. The unit cell contains eight atoms, $a_0 = 4\cdot795$ Å., $b_0 = 7\cdot255$ Å. and $c_0 = 9\cdot780$ Å.; symmetry orthohombic bipyramidal, space group V_h^{18}, case (*f*); parameter *u*, taken along Groth's *x* axis $= 0\cdot150$, *v*, along the *y* axis $= 0\cdot117$; abnormal absorption effects due to crystal perfection are negligible. The atoms are grouped in molecules, I_2; distance between centres of atoms of a molecule $= 2\cdot70$ Å.; each atom is distant from its other neighbouring atoms by 3·54 or 4·35 Å. H. N. A.

2596. Atomic Arrangement in Crystals of the Alkali Platinithiocyanates. S. B. Hendricks and H. E. Merwin. *Am. J. Sci.* 15. *pp.* 487–494, *June*, 1928.

These compounds are of the coordination type, and form hexagonal crystals; substances of this type and crystal form had not previously been investigated. $K_2Pt(SCN)_6$, the ammonium and the rubidium salts were prepared, and data obtained from Laue and X-ray spectrum photographs. There is in each case one molecule in the unit cell; for the NH_4 salt $a = 6\cdot77$ Å., $c = 10\cdot45$ Å.; for the K salt $a = 6\cdot73$ Å., $c = 10\cdot26$ Å.; for the Rb salt $a = 6\cdot75$ Å.; $c = 10\cdot47$ Å. The two possible space groups are ${}_3Di_{-1}$ and ${}_3Di_{-3}$, and the positions of the Pt atom, the two alkali atoms and the sulphur atoms are defined in each of these groups and illustrated by diagrams; in both cases the platinum atom is surrounded by six sulphur atoms, the C and N atoms lying outside this group, while the relation between the $Pt(SCN)_6$ groups and the alkali atoms is similar to that between the cadmium atoms and the iodine atoms in CdI_2 for both space groups. H. N. A.

2597. Statistical Deduction of Atomic Properties. E. Fermi. *Accad. Lincei, Atti*, 7. *pp.* 342–346, *Feb.* 19, 1928.

Shows how this manner of deduction leads up with precision to the periodic series of the elements. A. D.

2598. Attempt to add an Electron to the Nucleus of an Atom. W. D. Harkins and W. B. Kay. *Phys. Rev.* 31. *pp.* 940–945, *June*, 1928.

Since the present theories of the atom indicate that an electron is attracted by the atom nucleus, they also suggest that the principal difficulty in accomplishing the addition of an electron is in obtaining such (unknown) conditions as make the attraction effective. Electrons with a velocity corresponding to 138,000 to 145,000 volts were caused to strike the surface of liquid mercury. The mercury served as an anti-kathode in an X-ray tube. (This work was done before the electron tube of Coolidge was available.) When the experiments were begun it was not expected that positive results would be attained, since either the voltage may be too low or the number of electrons shot into the surface (4×10^{21}) too small, but it was thought to be of value to show this to be true. The addition of an electron to the nucleus of an atom of mercury should give an atom of gold. Since no gold was found in the exceedingly sensitive tests used, it is shown that either less than one in a billion of the electrons attached itself to an atom nucleus, or else all or a part of the nuclei produced were not sufficiently stable to endure for the period (24 to 48 hours) of the tests. AUTHORS.

2599. Photoelectric Dissociation of Sodium Iodide. A. C. G. Mitchell. *Zeits. f. Phys.* 49. 3–4. *pp.* 228–236, 1928.

The optical dissociation of a molecule of sodium iodode produces an iodine atom and an excited sodium atom which separate with relative kinetic energy. By observing the Doppler broadening perpendicular to the exciting beam and parallel to it respectively, it is shown that the atoms do not separate in any favoured direction, nor is the D-line fluorescence sensibly polarised. E. E. F. d'A.

2600. Control of the Molecular Weight of Liquid Hydrocarbons produced by Electrical Discharge in Ethane. S. C. Lind and G. Glockler. *Am. Chem. Soc., J.* 50. *pp.* 1767–1772, *June*, 1928.

The results of several workers on the chemical action of α-particles on paraffins are briefly considered, and it is pointed out that this action is not confined to the gaseous members. The various types of discharge vessels used are fully described. It is shown that silent, corona and high-frequency discharges all cause the condensation of ethane to liquid with liberation of permanent gases and that the average molecular weight of the liquid products can be controlled by the time that the first products, either gaseous or liquid, are allowed to stay in the discharge tube. J. K.

2601. Surface Layer of Liquids and Size of Molecules. S. G. Mokrushin. *J. Phys. Chem.* 32. *pp.* 879–881, *June*, 1928.

Ostwald connected the latent heat of evaporation λ, the surface tension σ and the area of the liquid surface Ω by $\lambda/2 = \sigma\Omega$. The surface energy of molecules lying in the liquid-vapour interface would be half of their latent heat of evaporation. Assuming that each molecule is a cube, the cubes being closely packed, and that the volume of a molecule in the liquid state is M/d, M being the molecular weight in the vapour state and d the density of the liquid, Ostwald's M/d would be equal to Ωl, where l is the side of the cube, and $l = 2\sigma M/\lambda d$. But the molecules are more likely spherical or ellipsoidal in the surface layer, and the surface energy of closely packed cubes would only be one-sixth, and not one-half of that in the vapour state. The author suggests $\lambda_i = S\sigma$, where $S = N\pi d^2$ = the molecular surface in the vapour state, λ_i being the internal latent heat of evaporation, N Avogadro's number and d the molecular diameter. The d values thus calculated closely approach those of Sirk [see Abstracts 474 and 1819 (1925)], determined by Debye's method. The surface layer is unimolecular; at the boiling point the molecules of a liquid have the structure of a honeycomb, and the density of the surface layer is less than that of the bulk of the liquid. The author's diameter of the water molecule, 5·12 Å., agrees with those deduced from other considerations. H. B

2602. Diameter of the CH_2 Chain in Aliphatic Acids. C. S. Piggot. *Washington Acad. Sci., J.* 18. *pp.* 330–333, *June* 19, 1928.

The discovery of an X-ray spectrum from paraffin wax, previously thought to be amorphous, encouraged the investigation of a number of aliphatic acids with from 14 to 21 carbon atoms. The short dimension of all acids studied was found to be $4 \cdot 235 \times 10^{-8}$ cm., indicating that this is the diameter of all organic CH_2 chains. F. S.

2603. Thin Films containing Benzene Rings. N. K. Adam. *Roy. Soc., Proc.* 119. *pp.* 628–644, *July* 4, 1928.

Forms Part XI of the series of papers on the structure of thin films and deals with numerous resorcinol and phloroglucinol derivatives. From none of the compounds could films be obtained in which the benzene ring was flat on the water surface closely packed against the rings of neighbouring molecules. It was not therefore possible to measure the cross-section of the benzene ring parallel to the plane of the ring. In most compounds with several hydroxyl groups in the molecule the rings stood up perpendicular to the surface. Films from compounds with methoxyl groups were of the " expanded " type. The alkyl resorcinols only formed both condensed and expanded films. Compounds with a resorcinol group at each end of a long chain form gaseous films. Humulone forms a peculiar film in which the ring is probably flat on the water and closely packed against the neighbouring rings, but complications prevent measurement of the ring size. W. H. GE.

2604. Work of the Bartol Foundation. W. F. G. Swann. *Frank. Inst. J.* 205. *pp.* 767–829, *June*, 1928.

This is a report on the work of the Bartol Foundation by the Director, and gives an account of researches which are being carried on at the present time. The chief subjects dealt with are : The emission of electrons from wires under the influence of intense electric fields, by **del Rosario;** the electrical conductivities of non-aqueous solutions, investigated by **O. E. Frivold;** the excitation of spectra in mercury vapour by electron impact, experiments by **Maxwell;** a research by **Barton** on the production of X-rays by positive ions; an inquiry into the loss of energy by electrons in the production of characteristic X-radiation, conducted by **Miss Allen;** an attempt to detect a magnetic field as a result of the rapid rotation of a copper sphere, by **Swann** and **Longacre;** the investigation of the effect of an electric field on the production of double refraction in sodium vapour, by **Bramley,** and of the variation of dielectric constant of a solution with concentration of the dissolved salt, by the same author;

the nature of the processes occurring in certain electric arcs, by **Nottingham**; the reflection of H atoms from crystals, by **Johnson**; a description of a device for obtaining high potentials, by **Swann**; and an account by the same author of an investigation undertaken by him with the object of securing data regarding the so-called cosmic radiation. J. J. S.

2605. Quantum Theory of the Rotating Electron. F. Möglich. *Zeits. f. Phys.* 48. 11–12. *pp.* 852–867, 1928.

Some mathematical amplifications are given of Dirac's theory of the "spinning" electron [see Abstracts 1168 and 1507 (1928)]. Transformation matrices are determined which for the electron spin and the eigen functions take the place of the Lorentz transformation. An invariant "Lagrange function" is derived from which both Dirac's equations and the Maxwellian equations can be obtained by variation. The energy-impulse tensor of the material waves is easily evaluated using the Lagrange function, and, unlike that given earlier by Schrödinger, is not a symmetrical tensor. W. S. S.

2606. Notes on Dirac's Theory of the Relativistic Rotation Electron. J. v. Neumann. *Zeits. f. Phys.* 48. 11–12. *pp.* 868–881, 1928.

In a close analysis of the Dirac theory [see Abstracts 1168 and 1507 (1928)] the nature of the monochromatic de Broglie waves and the transformation properties of the four ψ components and of the energy-current vector (the time component of which is the probability) are considered. The significance of the indeterminateness of sign of the electronic charge, which leads in the theory to four wave functions instead of two, is also discussed. W. S. S.

2607. Aperiodic Processes in Wave Mechanics. G. Wentzel. *Phys. Zeits.* 29. *pp.* 321–337, *June* 1, 1928.

A mathematical sketch is given of the treatment of problems of atomic mechanics involving aperiodic processes, such as the scattering of an electron stream by an atomic system, using the methods of wave mechanics. The general principles of Schrödinger's wave theory are first laid down and the notions of "density," "current density" and "velocity" of the electrons are developed. The solutions for free electrons and for closed systems lead on to an account of Born's theory of electron collision [see Abstracts 2532 (1926) and 43 (1927)]. The third chapter deals with the more general theory in which the dependence of the ψ function on the time is taken into account. The theory is applied to calculate the "yield" and other characteristic magnitudes, in the photoelectric effect. Radiationless jumps (Auger effect) are also discussed. W. S. S.

2608. Relationship between the Integrals of the Quantum Mechanics Equations of Motion and the Schrödinger Wave Equations. V. Fock. *Zeits. f. Phys.* 49. 5–6. *pp.* 323–338, 1928.

The proposition is established that when the functions $\psi_n(q, t)$ $(n = 1, 2 \ldots)$ satisfy the Schrödinger equation and for $t = 0$ have the property that they form a completely normal orthogonal system, then this property is true for all values of t. Further, the specific functions of an operator which correspond to an integral of the equations of motion can be so arranged that they satisfy the Schrödinger equation. The harmonic oscillator whose instantaneous period is a quadratic function of the time is treated as an application of the last proposition. H. H. Ho.

2609. Chemical Constant in the New Quantum Statistics. G. E. Gibson and W. Heitler. *Zeits. f. Phys.* 49. 7–8. *pp.* 465–472, 1928.

The fact that the two nuclei of a diatomic molecule with the same atoms are satisfied either by the Fermi or Bose statistics is now found to lead to the same result as the introduction of a symmetry number 2 in the Boltzmann statistics. The dissociation equilibrium constant J_2 has been calculated from known optical data and found to be in exact agreement with the experimental result. H. H. Ho.

2610. Relativity in Five Dimensions. A. Carrelli. *Accad. Lincei, Atti,* 7. *pp.* 566–567, *April* 1, 1928.

It is sufficient to conceive the motion of a charged electron as motion along a geodetic in a five-dimensional space. This works out better than Weyl's theory or Klein's, and takes in the rotation of the electron upon itself; and it leads to quantics. A. D.

2611. Deduction of the Field Equations of the General Theory of Relativity. H. Mandel. *Zeits. f. Phys.* 49. 9–10. *pp.* 697–704, 1928.

The invariant theory of pseudo-projection developed in previous papers [see Abstracts 64 (1927) and 275 (1928)] is completed. Certain difficulties inherent to classical micro-mechanics are correlated with R_5 of the theory. J. S. G. T.

2612. Movements of the Ether. Corps. *Comptes Rendus,* 186. *pp.* 1351–1353, *May* 14, 1928.

Reference is made to the experiments of Esclangon [see Abstract 1214 (1928)] which indicate the possibility of detecting an absolute motion of the earth. On the classical theory the total velocity of the earth would then be not less than 75 km. per sec., and probably much greater. But how should such a velocity escape previous observations, which show that the horizontal component of the apparent ether wind does not exceed 9 km. per sec.? The small result of the experiments of Michelson and Morley and of Miller may be due to the contraction of the moving bodies, but if this existed it would affect Esclangon's measurements by causing change of orientation of the mirrors. The explanation of the author previously presented is that by condensation of the ether at points of space successively occupied by material atoms the intensity of the ether wind is made variable, its vertical component is raised in a high ratio, and its horizontal component is inversely reduced. In previous experiments the result depended on the horizontal component; in Esclangon's it depends on the mean proportional between the horizontal and vertical components. An arrangement which brought to bear the vertical component might give a result still higher. But this movement of the telescope in a vertical plane might bring in a systematic error, the bending of the telescope varying with its inclination. J. J. S.

METEOROLOGY AND GEOPHYSICS.

2613. Effect of Wind Direction on Observed Latitude. S. Kawasaki. *Imp. Acad. Tokyo, Proc.* 4. *pp.* 191–194, *May*, 1928. *In English.*

Values of wind direction, during the interval when latitude observations were made, were extracted from autographic records for Mizusawa and Carloforte. In a table the residual of mean values of corrected latitude for eight wind groups are set out for the four seasons and for the year. At Mizusawa the effect is greatest for W.-W.N.W. winds and least for E.-E.S.E. At Carloforte the results were not so consistent. The results were also set as harmonic expressions. The author concludes that (1) the observed value of latitude has a close correlation with the direction of the wind, and (2) the effect of the wind gives rise to an annual variation in the observed latitude, which probably forms a part of the z-term. R. S. R.

2614. Relations between Cold Currents, Oceanic Regions of Drought, and Insular and Coastal Deserts in Tropical and Sub-Tropical Regions. L. Aufrère. *Comptes Rendus*, 186. *pp.* 1563–1565, *June* 4, 1928.

The author considers that the oceanic movement imposed by the wind determines the locality of the cold water in the south-eastern part of tropical and sub-tropical anticyclones. The negative temperature anomalies resulting produce an extension of the anticyclone and a stability which depressions of the temperate and tropical zones cannot in general overcome. Thus drought results in these parts. Coastal configuration may cause a displacement of the cold current and its replacement by the warm equatorial current. Around the great continental deserts the proximity of cold-water currents is the cause of the excessive dryness and is exemplified west of the Andes in "Humboldt's Desert." The tendency for droughts extends to the limits of the cold currents. Examples are given where these conditions hold. R. S. R.

2615. Mixed Conditions at Boundaries: Oceans and Continents, Stationary Water. M. Brillouin. *Comptes Rendus*, 186. *pp.* 1665–1669, *June* 18, 1928.

Reference is made to the results obtained in an earlier paper (*ibid.*, 184. pp. 849–853, April 4, 1927), where a complete set of functions was obtained which were useful in calculations for stationary water with continents on a deformable globe or on a spherical elastic isotropic homogeneous sphere. The method employed leaves some uncertainty regarding the results obtained. In the present paper a mathematical treatment is given by a direct method which is general in application and holds for the mixed problem, but is somewhat longer. R. S. R.

2616. Propagation of Love Waves Along a Doubly Stratified Layer. T. Matuzawa. *Phys. Math. Soc. Japan, Proc.* 10. *pp.* 25–33, *March*, 1928. *In English.*

In this mathematical paper the effect of double stratification on surface waves has been investigated, attention being confined only to waves of the Love type owing to the complex mathematical form of the Rayleigh waves. For one and the same distribution of strain in the middle layer two kinds of different distributions of strain are found in the first and deepest layers when the velocity of wave propagation exceeds that in the middle layer, and accordingly two systems of waves with different wave-lengths can be propagated. Numerical examples are included. H. H. Ho.

2617. Effect of an Irregular Succession of Impulses upon a Simple Vibrating System: Its Bearing upon Seismometry. T. Terada and U. Nakaya. *Imp. Acad. Tokyo, Proc.* **4.** *pp.* 208–210, *May,* 1928. *In English.*

A pendulum was subjected to the impact of two opposite streams of shots impinging upon targets fixed to the pendulum rod near its lower end and along the line of swing. The motion of the pendulum was recorded, and the general characters show a striking resemblance to those of the records of earthquakes or microseismic waves obtained with ordinary seismographs. The same may be said for the records of the secondary undulations of tides in bays or of the "seiches" of lakes. However, while seismograms are the only data it is almost impossible to tell whether the motion transmitted as earthquake waves is or is not in reality a succession of pulses. R. S. R.

2618. Postseismic Slow Vertical Displacement of the Earth's Crust and Isostasy. T. Terada and N. Miyabe. *Imp. Acad: Tokyo, Proc.* **4.** *pp.* 218–221, *May,* 1928. *In English.*

The object of the paper is to direct attention to the probable significance of the density changes in the earth's crust brought about by earthquakes, which may determine the postseismic adjustment of equilibrium in the disturbed region. The working hypothesis proposed has been applied successfully in the Muira Peninsula for events connected with the Great Earthquake and the other regions of Japan, and seems to promise further applications in a wider domain of geophysics. R. S. R.

2619. Horizontal Displacement of the Earth's Crust produced by the Tango Earthquake. T. Terada and N. Miyabe. *Imp. Acad. Tokyo, Proc.* **4.** *pp.* 211–214, *May,* 1928. *In English.*

The authors give the results of an investigation made to visualise the approximate mode of deformation of the earth's crust in the Tango district. The method used was similar to that employed for the Kwanto earthquake [see Abstract 2281 (1928)]. Zones of dilatation and compression were found and are indicated by diagrams. R. S. R.

2620. Relation between the Horizontal Deformation and the Postseismic Vertical Displacement of the Earth's Crust, which Accompanied the Tango Earthquake. T. Terada and N. Miyabe. *Imp. Acad. Tokyo, Proc.* **4.** *pp.* 215–217, *May,* 1928. *In English.*

Examination of the geographical distribution of the vertical displacements in the Tango district and comparison with the authors' investigation [see preceding Abstract] of the horizontal deformation indicated a correlation between them with a minimum at about 4–6 km. east of the Gomura fault and a maximum near or somewhere to the west of the fault. R. S. R.

ASTROPHYSICS.

2621. Activity and Height of the Solar Chromosphere in 1927. G. Abetti. *Accad. Lincei, Atti,* 7. *pp.* 445–448, *March* 18, 1928.

Gives and compares the results obtained at the observatories of Arcelri and of Madrid. As the cycle progresses from minimum to maximum, the high-latitude protuberances travel towards the poles with a general diminution in their complexive area, while the height of the chromosphere falls off from a polar maximum. The low-latitude protuberances in their activity follow the sunspots, and at the maximum of the cycle they influence the height of the chromosphere, which is then at a maximum.

A. D.

2622. Sun's Outer Atmosphere. E. A. Milne. *Roy. Inst. Proc. Advance Proof* (9 *pp*.). *Received June*, 1928. *Nature*, 121. *pp*. 911–913, *June* 16, 1928.

Of the four outer regions of the sun—photosphere, reversing layer, chromosphere, and corona—the third is here particularly discussed. The light of the sun's continuous spectrum originates in the photospheric layers, where pressure ranges from 10^{-3} to 10^{-6} atmospheres; and the Fraunhofer or absorption-line spectrum originates in the reversing layer; but these shade into one another, absorption beginning to show at about a pressure of 10^{-4} and continuing up to a pressure of about 10^{-7} atmospheres. In the upper reversing layer selective radiation pressure begins to appear, and increases steadily in importance, until we reach the chromosphere, into which atoms, acted on by a radiation pressure exceeding gravity, are ejected from the layers below. A table is given showing the heights to which various elements ascend in the chromosphere, measured at eclipses by the lengths of their arcs. Roughly speaking, the height for each region is: photosphere some tens of kilometres, reversing layer hundreds of km., chromosphere thousands of km.; and it is added that solar prominences rise to tens of thousands and the corona to hundreds of thousands of km. In the chromosphere, where density is very low and collisions of atoms are few, radiation is no longer transformed in wave-length, but passes on unchanged, a state which is known as monochromatic radiative equilibrium. Here each kind of atom should produce its own radiation gradient; and the more nearly an outer atmosphere in a particular kind of atom is in monochromatic radiative equilibrium, the more nearly the ratio of the residual intensity in the line-centre at the limb to that of the disc should approach the value 2/5. This point is now being investigated at several observatories, and it will be of interest to see to what extent it holds. The transition region between reversing layer and chromosphere also propounds an attractive puzzle for mathematicians and solar physicists.

M. A. E.

2623. Relative Intensity of the Spectral Lines Hα(H) and D_3(He) in Different Heights of Protuberance. E. J. Perepelkin. *Zeits. f. Phys.* 49. 3–4. *pp*. 295–305, 1928.

The paper is a record of the author's observations at Simferopol. The relative intensities of the spectral lines Hα and D_3 were measured in different heights of protuberance whereby the intensities of the same lines in the chromosphere at a visible height up to 5″ above the edge of the sun's periphery served as a constant light source. The results of these observations not only evolve a method for the estimation of the approximate actual height, but also allow the deduction of the ratio (k) of the intensity of the line $D_3(J_{D_3})$ to the intensity of the line $H\alpha(J_{H\alpha})$. By deduction it is found that k is a function of the intensity $J_{H\alpha}$ and the height H, and if all values of k are reduced to the case $J_{H\alpha} = 10$, then the relationship is expressed by a definite equation. For protuberances contained within the visible height of 5″, $k = 77\ \%$, whilst this ratio for the chromosphere for the same height should be 100 %. These results can be explained in two different ways: either the quantity of helium in the protuberance is less in proportion to the quantity of hydrogen than the ratio of these two gases in the chromosphere, or in the greater optical depth of the layer of the chromosphere, in comparison with that of the protuberance, there exists a self-reversal of the line. The increase of the value of k with height, which at a height of 37,000 km. is equal to $0{\cdot}40 \pm 0{\cdot}08\ \%/1000$ km., can be explained on account of the ionisation of the hydrogen. S. G. B.

2624. Gurney's Theory Tested by Helium Lines in the Chromosphere. W. Anderson. *Zeits. f. Phys.* 49. 9–10. *pp.* 749–752, 1928.

Solar rays exercise only a very slight radiation-pressure on Ca^{++} atoms, far too small to balance the effect of gravitation. When, therefore, Ca^{++} atoms occur in the chromosphere, they must fall in obedience to gravity and attain a relatively very high velocity owing to the small density. Gurney has propounded the hypothesis [see Abstract 2093 (1928)] that these rapidly-moving atoms falling down upon the gases of the chromosphere may produce a marked effect in exciting and ionising them. The hypothesis is here tested by comparing it with the remarkable eclipse observations of Davidson and Stratton [see Abstract 2231 (1927)]. They found that the ionised line of helium, $\lambda 4686$, could only be traced to 2500 km. above the sun's limb, although the neutral helium line $\lambda 5876$ reached 7500 km. It appears that these heights are in good quantitative agreement with the theory, and in any case the appearance of the line $\lambda 4686$ can scarcely be explained unless it is accepted. M. A. E.

2625. Separation of Gases in Prominences. S. R. Pike. *Roy. Astron. Soc., M.N.* 88. *pp.* 635–640, *June,* 1928.

Expressions have recently been worked out [see Abstract 569 (1928)] for the velocities and accelerations of atoms in the sun's chromosphere on the assumption that the motions are controlled entirely by gravity and radiation-pressure, but exact results could only be given in the case of Ca^+ owing to lack of the necessary data. Further measurements have now become available for Ca^+ and also for several other elements, and therefore the numerical treatment of certain equations already given has now been worked out in greater detail. The result is important, for a considerable sorting out of a mixture of gases moving under radiation-pressure is indicated, and thus it should be possible, by observing the simultaneous motions of different gases in one prominence, to make an observational test of the radiation-pressure theory. In the case of prominences near sunspots, which are assumed to be moving downwards and horizontally towards the sunspot, the inflow of H and Ca^+ should be very much faster than that of the associated group Sr^+, Fe, and Ti; whilst in eruptive prominences, supposed to be due to the development of faculæ and, therefore, always with velocities upward and away from the disturbed areas,

Sr^+, Fe and Ti should move faster than H and Ca^+, and in either case there should be a separation of the two groups sufficiently marked to be easily observable. M. A. E.

2626. Solar Prominence of 1928, May 7-9. J. Evershed. *Observatory*, 51. *pp.* 180–181, *June*, 1928.

This prominence observed on the sun's east limit, was also seen fourteen days earlier on the west limit and had all the characteristics of a stable and enduring type. But when seen on May 9th, at 7 h. 16 m. (summer-time), it had greatly increased in height with violent spectral changes; at 7 h. 46 m. parts showed relative motion of 200 km./sec.; it broke up an hour later; and at 9 h. 30 m. only a few wisps were visible. On May 8th the spectrum showed the shift towards the violet, due to rotation, compensated by the redward shift, due to the Einstein effect, so that the solar and terrestrial lines were almost in coincidence, thus demonstrating the Einstein shift. A. S. D. M.

2627. Presence of Boron in the Sun. S. B. Nicholson and N. G. Perrakis. *Comptes Rendus*, 186. *pp.* 1523–1524, *June* 4, 1928.

The apparent absence of boron in the solar atmosphere is most likely due to the fact that the usual spectrum of boron is to be found in the ultra-violet region. It might possibly be identified by means of spectra of its chemical compounds, and a comparison of sunspot spectra with the spectrum of boric acid, for a wave-length range of 4645–5137 Å., revealed the presence of 25 lines which could be attributed to boric acid. R. C. F.

2628. Sunspot Cycles. S. Oppenheim. *Akad. Wiss. Wien, Ber.* 137. 2*a*. 1–2. *pp.* 127–146, 1928. *In German.*

A satisfactory formula for sunspot frequencies has not yet been found, although many attempts have been made. Wolf's figures bring out clearly the period of 11 years, yet this varies quite irregularly from 8 to nearly 17 years, and mathematicians have tried to solve the difficulty by superposing upon it a number of minor cycles, or have regarded it as subject to sudden changes taking place at long intervals. The object of the present paper, which is entirely mathematical, is to show that a formula can be found by assuming, in addition to the main period of about 11 years, one secondary period of not less than 180 years. The observational material used is that of Wolf and of Greenwich, and curves of the sunspot frequency, from the year 1750 to 1940, derived from observation and from calculation, show a close resemblance. In terrestrial magnetism, which has an 11-year cycle corresponding with the sunspot cycle, there is also a secular period in the declination and inclination, and this doubtless is connected with the secular period of the sun. It is suggested that some variable stars are of the same type as our variable sun, and two of these are discussed, *viz.*, Mira and R.V. Tauri. It is probable that both, like the sun, have a main period complicated by a secular period, for Mira 332 days and about 218 years, for R.V. Tauri 39 days and 1285 days. M. A. E.

2629. Variation of Illumination during Eclipse. Staff of Photometry Dept., National Physical Laboratory. *Illum. Eng., London*, 21. *pp.* 198–202, *July*, 1928.

Describes the methods used and the results obtained by the expedition sent to Leyburn, Yorks, on the occasion of the total eclipse, June, 1927.

The measurements made were of (*a*) the illumination of a horizontal surface due to the whole sky, and (*b*) the illumination of a surface placed normal to the sun's rays. Observations were made at close intervals for nearly 1¼ hours before until 1¼ hours after totality. It was hoped to obtain a measure of the direct light from the corona, but weather conditions made this impossible. The minimum value obtained under (*a*) was 0·18 ft.-candle and under (*b*) 0·08 ft.-candle. The results obtained by other investigators observing at other stations are summarised. J. W. T. W.

2630. Theory of the Secular Perturbation of Higher Degrees. Y. Hagihara. *Phys. Math. Soc. Japan, Proc.* 10. *pp.* 1–14, *Jan.–Feb.*, 1928. *In English.*

It is well known that the ordinary Lagrangean solution in the planetary theory is not valid when the mean motions in the first approximation of any two-planets are exactly or nearly commensurable. A similar difficulty occurs in the theory of secular perturbations when we proceed to higher approximations. To avoid this difficulty, a new method is here suggested. The solution is proved to be convergent and purely periodic if certain conditions are satisfied. The results are extended to treat the problem of the general form of the solution of planetary motion, and are applied to establish the stability of the solar system. M. A. E.

2631. Origin of the Aurora Borealis. E. O. Hulbert. *Terr. Mag.* 33. *pp.* 11–13, *March*, 1928. *Phys. Rev.* 31. *pp.* 1038–1039, *June*, 1928.

According to a theory developed by Birkeland, Störmer, Vegard and others, the aurora is caused by charged particles emitted from the sun, which under the influence of the magnetic field of the earth are diverted to the polar regions, and there their energy is given to the atmosphere and by some process converted partially or wholly into the auroral light. There are difficulties in this theory, and it is here suggested that a more probable cause is the ultra-violet light coming from the sun to the earth. Part of this is absorbed in the high atmosphere of the earth and produces ions and electrons, these diffuse with little recombination because of the low pressure, they drift along the earth's magnetic field and concentrate in the polar regions, descend to lower levels and recombine, setting free their energy of recombination, which in some way causes the aurora. A very rough quantitative estimate of the intensity of the auroral illumination was made at Chebeague Island, Maine, during the strong display of August 20, 1927, the ultra-violet radiations of the aurora being compared with those from the moon; and the total energy of the auroral light upward and downward was found to be something like 10^{15} erg $\sec^{-1}$. In a calculation of the ionisation of the earth's upper atmosphere it has been shown that an energy 6×10^{13} erg $\sec.^{-1}$ is available to produce an aurora under the ordinary solar influence, and in times of sunspot activity it may be much more. M. A. E.

2632. Influence of Magnetic Perturbations on the Geographical Distribution of Auroræ. A. Røstad. *Geofysiske Publ. Oslo,* 5. 5. *pp.* 1–19, 1928.

As is well known, the frequency of auroræ increases with increasing terrestrial latitude until within 20° of the earth's magnetic pole, after which it decreases; and this fact, together with the evident connection of solar activity, magnetic storms, and auroræ, points to a close dependence of auroræ upon terrestrial magnetism. According to Birkeland and his followers, the source of an aurora is kathode rays from the sun which are caught in the earth's magnetic field. The present paper describes observations of the aurora made at Drontheim (Norway), supplemented by some from Oslo and the Netherlands, and compared with records of magnetic storms taken at Potsdam. The author concludes that auroræ are always accompanied by magnetic storms, the latter sometimes preceding; that the maxima of the two phenomena occur together; that the distribution of auroræ over the normal auroral zone increases greatly with increased intensity of the magnetic disturbance; that seasonal and daily periods affect both alike; and that at a given distance from the magnetic pole auroral streamers are accompanied by much greater storms than diffuse auroral glow. M. A. E.

2633. The Hecuba Gap in the Distribution of the Minor Planets. Y. Hagihara. *Phys. Math. Soc. Japan, Proc.* 10. *pp.* 15–24, *Jan.–Feb.*, 1928. *In German.*

The recent work of Wilkens, by which it was sought to explain the existence of gaps in the orbits of the asteroids, is here developed with the special aim of explaining the most difficult case, the Hecuba gap.

M. A. E.

2634. Photographic Measures of Saturn's Satellites in 1926. H. L. Alden and W. C. O'Connell. *Astron. J.* 38. *No.* 893. *pp.* 53–56, *Jan.* 23, 1928.

Sixty-six backed plates with several exposures of 30 to 90 seconds on each plate (Saturn being moved in declination between exposures) were taken with the new 26-in. photographic refractor of the Yale Southern Station for comparison with the visual observations made by G. Struve at the Union Observatory, Johannesburg; the plates, oriented by star trails, were measured with the Zeiss stereocomparator. Titan was used for guiding. Images are measurable of Enceladus in nearly all parts of its orbit and of Mimas at elongation. The various sources of error of the stereocomparator, of the plate scale, of orientation, and of measurement are investigated. A table is given of the positions of Titan, Rhea, Dione, Enceladus and Japetus from April 26 to August 13, 1926, and referred to Tethys as origin. A. S. D. M.

2635. Determination of the Diameter of Mars. P. van de Kamp. *Astron. J.* 38. *No.* 894. *pp.* 61–71, *Feb.* 17, 1928.

The diameter of Mars at unit-distance, as derived from 123 photographic images taken through a yellow screen in the focus of the 26-in. refractor at the Leander McCormick Observatory, between July, 1924, and March, 1927, is found to be 9″·48 ± 0″·06. The author describes his methods, and points out ways in which errors may be avoided. Photographs in yellow light give clear-cut images, suitable for accurate measurement, chiefly because of the very limited range of wave-length employed.

M. A. E.

2636. Wider Aspects of Cosmogony. J. H. Jeans. *Roy. Soc. Arts, J.* 76. *pp.* 611–623; *Disc.*, 623–626, *April* 27, 1928. *Trueman Wood Lecture. Nature,* 121. *pp.* 463–470, *March* 24, 1928. *Supplement.*

The lecturer dealt first with the scale of time, the earth's history, man's existence on it, and the distance away of celestial objects. Space itself he considered limited and light takes 10^{11} years to travel round the universe. The great star nebulæ are of vast size and enormous variety. The star structures were similar to atomic with electronic rings (0, 1, 2 or 3 rings, but no fractional numbers). The sizes of the stars disclose the atomic weights of the stellar atoms and indicate something heavier than uranium. The ages of the stars can be calculated from (1) the shape of the orbit, the rate of change from the original circle being known, (2) the breaking up of the orderly formation of moving clusters of stars by the action of other stars, the lighter ones in the cluster being lost first and (3) the tendency for the energy of motion of different types of stars to equalise. All the methods give the age 5 to 10 × 10^{12} years. The energy produced is due to radiation generated by the falling together of electrons and protons and thus a change from matter to energy. There is some evidence of this change of mass. The radiation liberated at the centre of stars decreases its wave-length and becomes light and heat when it emerges. If such radiation were produced outside the stars, this would account for the penetrating cosmic rays found by Millikan and originating in great nebulæ. Photographs of nebulæ indicate the successive shapes of the gaseous matter as it cools while rotating. Our galactic system of stars is an example, the milky way being the equatorial plane of the original nebula. The approach of two stars may give rise to planets as in our solar system. In the *Discussion*, **O. Lodge** raised the questions whether time as well as space is finite, how the heavy atoms hold together at stellar centres at the excessive temperatures existing there, and what happened to all the radiation emitted. R. S. R.

2637. Ballistic Theory of Variable Stars. C. Cannata. *Accad. Lincei, Atti*, 7. *pp.* 337–341, *Feb.* 19, 1928.

Various particular cases are worked out, with numerical results, giving different varieties of fluctuations in luminous intensity. A. D.

2638. Atmospheric Extinction of Light in Rome. E. Bianchi. *Accad. Lincei, Atti*, 7. *pp.* 441–445, *March* 18, 1928.

Criticises Andrissi [see Abstract 1863 (1928)], who had disagreed with the author as to the amount of atmospheric extinction of starlight. A. D.

2639. Balance of Radiation in the Stars, Part II. E. Hopf. *Zeits. f. Phys.* 49. 3–4. *pp.* 155–161, 1928.

The conclusion is reached that in Milne's theory of radiation balance in an infinitely thick medium with layers in parallel planes the temperature is determined as a function of the optical depth under the plane boundaries having one definite meaning, if the effective temperature of the radiating medium is known. [See also Abstract 1213 (1928).] **Errata,** *ibid.*, 49. 9–10. p. 752, 1928. J. J. S.

2640. Henry Draper Extension. Annie J. Cannon. *Harvard Coll. Obs. Annals*, 100. *pp.* 49–60, *Feb.* 1, 1928.

The spectra of 4200 stars of the Helsingfors-Gotha Catalogue of the Astronomische Gesellschaft are here given, the table including all stars not already in the Henry Draper Catalogue which could be classified in the zones + 55° to + 60°, 1855. The table has the same form as that published in No. 3 of this volume of the Annals. [See Abstract 943 (1927)]. M. A. E.

2641. Upper Limit of Mass for a Star. G. I. Pokrowski. *Zeits. f. Phys.* 49. 7–8. *pp.* 587–589, 1928. *In German.*

It follows from the law of gravitation that when a compact mass of matter increases in density, its free energy diminishes. If a body of maximum mass should contract until its density equalled the density of the atomic kernel, the gravitational potential at its surface would reach the value of C^2, and in this case no energy could leave the mass. The fact that there is an upper limit for the mass of the fixed stars indicates that such a potential can never be reached. M. A. E.

2642. Deviation of Stellar Material from Perfect Gas. A. S. Eddington. *Roy. Astron. Soc., M.N.* 88. *pp.* 352–369, *March,* 1928.

An investigation into the applicability of Debye and Hückel's method [see Abstract 2328 (1923)] to the stars as has been done by Rosseland [see Abstract 54 (1925)] and by Fowler and Guggenheim [see Abstract 493 (1926)]. The author assumes (1) that the correction to pressure is one-third the electrostatic energy; (2) that the frequency of any configuration is $exp(-W/RT)d\omega$ and proposes a separate theory for stellar gas which is not applicable to electrolytes. He substantiates the Debye-Hückel theory up to their equations $\Delta^2\overline{\psi}_a = -4\pi\overline{\rho}$ and $\overline{\rho} = \text{const.} \times M\,(exp - Ze\psi_a/RT)$, but finds that their next step, $M(exp - Ze\psi_a/RT) = exp - Ze\overline{\psi}_a/RT$, cannot be applied except in cases of no astronomical interest. Therefore, instead of considering the mean charge density due to the ions, he discusses the mean charge density due to the electrons, allowing the ions to be placed in the most unfavourable way; bound electrons below the fourth quantum orbit being considered as part of the ion. He finds that there can be no tendency for the ions to cluster and that the pressure in an ionised gas can never be less than the pressure in the corresponding un-ionised gas. He takes numerical stellar conditions as in his former paper [see Abstract 946 (1926)]. The most likely value of the ion average energy is $-\frac{1}{2}Z^2e^2y\,(1\cdot94)$ as compared with $-\frac{1}{2}Z^2e^2y(1\cdot55)$ of his previous paper, and this new value is confirmed by a calculation of the energy of a face-centred cubic lattice. The whole electrostatic energy of the gas is $-V = -\frac{1}{2}Z^2e^2y\,(2\cdot1)$ per ion, and the ratio of electrostatic pressure to gas pressure is $= 0\cdot091$. He considers the fluctuations which follow the error-law, and the proposition as to whether stellar gas can crystallise, not as a whole but by single elements or alloys forming crystals of a certain optimum size; this he judges to be doubtful. It is possible to deal thus with the stellar problem only because of the great disparity in charge between the ions and electrons; the method cannot be applied to a hydrogen star.

A. S. D. M.

2643. Debye-Hückel Theory and Stellar Atmospheres. J. A. Gaunt. *Roy. Astron. Soc., M.N.* 88. *pp.* 369–377, *March,* 1928.

The paper falls into two parts, one supplementary to R. H. Fowler's criticism of the theory [see Abstract 3232 (1927)], and pointing out an additional source of error, whose effect seems to be incalculable; the other part summarises an abortive attempt to distinguish between bound and free electrons in an ionised atmosphere [see preceding Abstract]. The treatment is mathematical throughout. A. S. D. M.

2644. Physical Conditions in New Stars. S. B. Pike. *Leeds Philosoph. and Lit. Soc., Proc.* 1. *pp.* 232–238, *April,* 1928.

The idea is gaining ground that the appearance of a nova is due to some sort of explosion in a single star, and the mixed bright and dark line spectrum has been shown by Evershed to be most easily explained on the hypothesis of one or more expanding shells of gas. These shells are presumably the chromosphere and reversing layer of the star, and the question arises whether the photosphere also moves outward to an appreciable extent. Nova Aquilæ 3 (1918) is the only nova for which all the data necessary for discussing this question exist, and the author shows that its changes in brightness during the early stages cannot be accounted for by a rise of temperature alone, but must be attributed partly to a large increase in radius. The later changes can only be studied by means of the theory of thermal ionisation, and it is shown that the variations in the spectrum, especially the strengthening and weakening of the lines of ionised helium, hydrogen and nebulium, point definitely to an increase in the degree of ionisation for a long time after the maximum. The star had regained its original magnitude by the year 1926, and either it had then a higher temperature and smaller radius (the photosphere having contracted again after the previous expansion), or the temperature never rose at any stage by more than about 1000° above normal. Until this question is settled there can be no satisfactory theory of novæ; but it is pointed out that Milne's theory of the expulsion of atoms under radiation pressure requires only a small rise in temperature, and that a rise of more than a few thousand degrees would produce far higher velocities than any actually observed. M. A. E.

2645. Contours of Stellar Absorption Lines and Composition of Stellar Atmospheres. Cecilia H. Payne. *Nat. Acad. Sci., Proc.* 14. *pp.* 399–406, *May*, 1928.

The theory by which line intensities have been interpreted has not until recently taken account of the shapes of spectral lines, but the theory of Unsöld concerning the formation of absorption lines suggests that a study of their shapes in stellar spectra may provide a new method of analysing stellar chromospheres. Hence, the writer has selected a few typical spectra from the Harvard collection and analysed the contours of the strongest lines, *viz.*, the H and K lines of ionised calcium and the Balmer lines of ionised hydrogen. Even from inspection it is evident that the contours of the hydrogen and calcium lines differ from one another, and alter from class to class, and from supergiant to dwarf within the same spectral class. The general agreement of the theory with the phenomena of spectral sequence having been found satisfactory, individual line contours were examined and the theory applied to them, with valuable results regarding the classification, the composition of the atmosphere, the absolute brightness, and the temperature of stars. In conclusion, the data derived for the number of calcium atoms in the ionised state above the photosphere is summarised in a diagram, which gives a picture of the progression in ionisation with spectral class, and also of the different amounts of atmosphere present for stars of about the same temperature but differing luminosity. Unsöld's method permits us virtually to weigh the atmospheres of individual stars. The process has here been performed for calcium, but with greater resolving power of the spectra it would be possible to carry out a detailed analysis for many other elements. M. A. E.

2646. Statistical Discussion of Proper Motions in "Prager's Katalog von 8803 Sternen zwischen 31° und 40° Nördlicher Deklination." J. Schilt. *Astron. J.* 38. *No.* 904. *pp.* 149–155, *June* 7, 1928.

The author divides Prager's catalogue into two groups: (1) those which do not, (2) those which do contain stars in Küstner's catalogue. For all spectra taken together and for those with large proper motions excluded, tables of centennial parallactic motions and of systematic difference between Groups (1) and (2) for six magnitude groups of stars are given. These show that there is no relative magnitude equation between Prager and the AG catalogues (Auwers' corrections being applied). For the fainter stars the proper motions in Prager's catalogue for Group (2) are systematically $+ 0^{s}\cdot 0007$ larger than for Group (1). The different magnitude groups are unsatisfactory in determining the galactic angular rotation, and a selection for this has to be made of stars without systematic peculiar motions and of about the same apparent as well as absolute magnitude. G stars contain dwarfs and are not homogeneous, but the faint K and F stars (median magnitudes 8·3 and 8·6 respectively) are examined, showing a difference in the positions of the apex of the two types of about 25°, indicating a relative motion of the K giants with respect to the F stars of about 10 km./sec. in the direction of Strömberg's axis. The A stars (magnitudes 8·0 to 8·8) are also examined, and the rotational effect is found among A stars having strong galactic concentration, and also for near F stars and distant K stars which are uniformly distributed over the sky. He discusses the residuals of the proper motions after the parallactic motion is taken out, and finds a strong correlation in right ascension for stars of magnitude 9·6 and 9·2. This may be due to some systematic error, but there may be a cosmic explanation of it. [See Abstract 303 (1928).] A. S. D. M.

2647. Variable Star T Vulpeculæ. G. Tiercy. *Arch. des Sciences*, 10. *pp.* 107–135, *March–April*, 1928.

To obtain the light curve the author measures the width of the spectral rays (especially H_β, H_δ, H_γ, H and K) and the length of the spectrum; from these he obtains a value *q* which varies in the same sense as the magnitude. The plates (mostly of Capelli-blu make) were taken by G. Abetti at Arcetri (Florence) in 1924 with a 30-cm. mirror, and are corrected for inequality of exposure, etc., and measured in the spectrocomparator. From a table and figure of *q*, the apparent (*m*) and absolute (M) magnitudes are found; at maximum light $M_v = -1\cdot 2$, giving the radius $R = 9\cdot 2R_\odot = 6{,}403{,}200$ km. (phase $4^d\cdot 432$). The spectra are compared with those of pseudo-cepheids and, from Beal's curve of radial velocities, a table of radii at other phases are found, giving at minimum light R = 5,723,004 km. (phase $3^d\cdot 075$); $R_{max.} = 7{,}210{,}736$ km. (phase $1^d\cdot 165$); and $R_{min.} = 5{,}265{,}928$ km. (phase $3^d\cdot 575$). The colour indices are calculated for the different phases from the equation, $0\cdot 819I = \log R + 0\cdot 20M_v - 0\cdot 515$, and tabulated giving $I_{max.} = 0\cdot 477$ at spectrum G, and $I_{min.} = 0\cdot 241$ at spectrum A_δ. The variation curve of I is obviously more symmetrical than the light curve. A curve of (I : *q*) is drawn and described. Formulæ are given connecting the temperature (T) with M_v and R, giving $T_{min.} = 6621°$ at phase $2^d\cdot 006$ and $T_{max.} = 8456°$ at phase $4^d\cdot 203$, that is $T_{min.}$ occurs at $I_{max.}$ and *vice versa*; and for the pressure P, $P_{min.} = 0\cdot 003653$ at phase $1^d\cdot 144$ ($R_{max.}$ being at $1^d\cdot 165$), and $P_{max.} = 0\cdot 007112$ at phase 3 ·575 coinciding with $R_{min.}$, so that the star spends more time in passing through the series of lower pressures than through those of higher; maximum compression seems less "supportable" than maximum dilation. A. S. D. M.

2648. Further Work on Interstellar Calcium. O. Struve. *Astrophys. J.* 67. *pp.* 353–390, *June*, 1928. *Abstract from Harvard Coll. Bull. No.* 857.

Intensities of the calcium line K have been estimated in 1718 stars of spectral type O–B3, and in 338 stars of later spectral subdivisions. This material has been used for the derivation of systematic errors and for the determination of the precision of such intensity estimates. After applying all necessary corrections the material was divided into groups according to spectral type and according to apparent magnitude. There appears to be a marked increase in the intensity of detached K for fainter stars, and for earlier spectral types. Be stars have also stronger calcium lines than absorption B stars. Several groups of physically connected stars were investigated separately, but there appears to be no certain evidence that luminosity or spectral type affect the intensity of K. The results were checked by means of the later types, and by means of estimates made on a stellar line in the vicinity of K. The various effects were not present in these instances, and their intensities closely followed the requirements of the theory of ionisation. It was proposed to neglect all sources affecting the intensity of detached K, save only the distance of the star, thus putting $I = f(D)$. This relationship was evaluated graphically from groups of stars whose distances are known with sufficient precision. It was then used for the derivation of distances and absolute magnitudes of certain other groups of stars. The results derived in this way are so consistent with other methods that the assumption $I = f(D)$ seems justified. [See also Abstract 2249 (1927).] AUTHOR.

2649. Identification of Lines in the Spectrum of η Carinæ. P. W. Merrill. *Mt. Wilson Observat. Contrib. No.* 354. *Astrophys. J.* 67. *pp.* 391–398, *June*, 1928.

The spectrum of η Carinæ consists essentially of emission lines, among which those of hydrogen and ionised iron have long been recognised. A few other lines are probably due to ionised titanium and ionised chromium. This paper identifies most of the remaining lines with forbidden lines arising from metastable states of the ionised iron atom. Low density is thought to be the condition which allows these non-laboratory lines to occur. Two curious instances of violations of the inner-quantum-number rules are noted. AUTHOR.

2650. Graphical Determination of Orbits of Visual Binary Stars. J. J. Nassau and P. D. Wilkins. *Astron. J.* 38. *No.* 893. *pp.* 56–59, *Jan.* 23. 1928.

Three graphs are drawn in rectangular coordinates: (1) time-position; (2) time-distance; (3) position-distance (derived from the other two). (1) and (2) give approximate values for the period and their mean is taken. For this mean value one period of a smooth curve for the plotted points may be drawn for position angle and for distance for any time, and from these two smooth curves a third smooth curve may be plotted of distance against position angle. The authors describe how the graphs may be used and they incorporate in this method some formulæ devised and used by Zwiers. Three figures give the results for 70 Ophiuchi. The objections to, and advantages of, the method are stated. A. S. D. M.

LIGHT.

2651. Distribution of Light between Two Absorbing Media. J. Plotnikow and K. Weber. *Zeits. f. Elektrochem.* 34. *pp.* 316–320, *June,* 1928.

The distribution of light between two absorbing media is discussed theoretically, and an analogy drawn between it and the mixing of two liquids. The proofs of the authors are contrasted with those of Langedijk and the differences are pointed out. By graphical representation of the results calculated from the two formulæ, that is, from the theory of the authors that the distribution follows a geometric law, and that of Langedijk that it follows an arithmetic law, a very clear view of the two theories is obtained. The possibility of two methods—a chemical and an optical—for the solution of the problem is considered. F. J. B.

2652. Absorption of Light by Iron Pentacarbonyl. J. Drechsler. *Zeits. f. Elektrochem.* 34. *pp.* 320–323, *June,* 1928.

The absorption of light by iron pentacarbonyl in different solvents for the range of the visible spectrum was measured by means of a Koenig-Martins-Grünbaum spectrophotometer. Beer's law was found to be obeyed for different thicknesses of layers and concentrations ranging from 99 % to 0·5 %. The absorption of light was found to be independent of the nature of the solvent. Kundt's law was not obeyed in this connection. The velocity of the light reaction depended on the nature of the medium, but no apparent connection between it and the dielectric constant could be observed. F. J. B.

2653. Metallic Reflection from Rock-Salt and Sylvite in the Far Ultra-Violet. A. H. Pfund. *Phys. Rev.* 32. *pp.* 39–43, *July,* 1928.

From the rapid rise of the dispersion curve of rock-salt and sylvite in the ultra-violet, the existence of regions of anomalous dispersion in the Schumann region have been long anticipated. By using a specially constructed vacuum tube in connection with a vacuum spectrograph the regions of metallic reflection for NaCl and KCl were found. From these results an estimate was made of the wave-lengths of the true resonance frequencies. The values 1547 Å. for NaCl and 1581 Å. for KCl are in remarkable agreement with those previously calculated by Herzfeld and Wolf [see Abstract 291 (1926)]. AUTHOR.

2654. In a Mixture of Two Liquids the Contractions of Refraction and Density have the Same Sign. L. Counson. *Arch. des Sciences,* 10. *pp.* 136–141, *March–April,* 1928.

The author has previously shown [see Abstract 453 (1924)] that in Pulfrich's relation $\alpha = (n - n_v)(n - 1)^{-1}/(D - D_v)D^{-1}$ is always positive [see Abstract 1160 (1910)]. The present paper is a study of the mixtures of the same solutions but in varying proportions, based on results published by Lattre, who obtained the relationship $[dD/D]\{dn/n\}^{-1} = 6n^2\{(n^2 - 1)(n^2 + 2)\}^{-1}$ between the variation dD of the intensity and the variation dn of the index in a mixture. He finds that not only for a single liquid is the ratio of the variations of density and index always positive, whatever the cause of the variations, but the same holds good for a mixture of two liquids. A. S. D. M.

2655. Demonstration of Reversed Rays. J. Zenneck. *Phys. Zeits.* 29. *pp.* 346–349, *June* 1, 1928.

A vessel contains a concentrated salt solution and above it a layer of water. If an illuminated ground glass plate is viewed through the two layers it appears uniformly bright. If light is projected through the vessel from a projection lamp a dark band appears where diffusion is going on between the salt solution and the water. The light is refracted in the diffusing layer and much of it cannot reach the screen. R. S. R.

2656. Formation of Diapositives by Projection. J. Zenneck. *Phys. Zeits.* 29. *pp.* 345–346, *June* 1, 1928.

The different types of images obtained when projecting objects with transmitted light or objects which are self-luminous are considered, and the different degrees of sharpness obtained as more or less of the condensing lens is illuminated. It is shown that with the use of a size of plate corrected for astigmatism the several pictures can be obtained not differing appreciably from one another. R. S. R.

2657. Acuteness of Vision. A. Danjon. *Rev. d'Optique,* 7. *pp.* 205–214. *May,* 1928.

Acuteness of vision is measured by the angle subtended by two threads of an illuminated system of parallel and equidistant threads when the eye is at just such a distance that the threads appear to melt into a uniform ground. The acuteness, so measured, varies with the amount of illumination and with the contrast between the threads and their background. The variation may be represented by an empirical formula containing two parameters, of which one is the contrast, the other a number which depends on the amount of illumination only. There is a simple relation between this latter parameter and the smallest contrast perceptible for a given amount of illumination. When the brightness of the field diminishes, the acuteness approaches a limit, about 12′. A. D.

2658. Light Filters for the Isolation of Narrow Spectral Regions. L. A. Jones. *Kodak Research Lab., Comm. No.* 335. *J.O.S.A. and R.S.I.* 16. *pp.* 259–271, *April,* 1928.

The light filters were required in the investigation of the action of radiation in the prevention and cure of rickets in white rats. A high intensity over a relatively large area was required. The materials used in various combinations were distilled water; aqueous solutions of $CaSO_4, 5H_2O$ and $NiSO_4, 7H_2O$; Corning glasses G986 Å., G586, and G980 Å.; and dyed gelatine Wratten filters 88 Å., 25, 61, and 49. In order to cover the wave-length range 200 to 1400 $m\mu$, four different spectrophotometers were used. The results are given in curves showing the relation between density and wave-length. As an example, a filter transmitting between 330 and 430 $m\mu$ with a maximum at 380 $m\mu$ was made by combining 2 cm. of 10 % copper sulphate solution with 3·2 mm. Corning glass G586. T. B.

2659. Reducing Prismatic Formulæ. H. N. Russell and A. G. Shenstone. *J.O.S.A. and R.S.I.* 16. *pp.* 298–301, *May,* 1928.

Hartmann's formula for the reduction of plates obtained with prism spectroscopes, $\lambda - \lambda_0 = C/(x - x_0)$, where x is the scale-reading for the spectral line, contains as few constants as is possible in any general formula for such reductions. It is, however, laborious in working out.

For certain types of instruments it is more commodious to use a formula $\nu = \nu_0 + ax + A - b(x - x_m)^2$, where A is the maximum of the curve of $(\nu - \nu_0 - ax)$ plotted against x, x_m is some point near the centre of the range, and $b = A/x_m^2$. The constants a, A and b may be determined from three standard lines. A. D.

2660. Standardisation in Apparatus for Science Teaching. W. Taylor. *Roy. Soc. Arts, J.* 76. *pp.* 787–799; *Disc.*, 799–804, *June* 15, 1928.

The advantages of standardisation, economy and convenience of uniform and simplified practice are first examined and illustrated by reference to the use of various sizes of paper, where a few sizes arranged in geometrical progression would supply a smaller number of standards combined with a big range. This would simplify the use of accessories such as envelopes, typewriters, filing cabinets, etc. Reference was next made to the work of the Committee on Glass and Optical Instruments under the Department of Scientific and Industrial Research during the war (1914–1918) and the great simplification obtained in the number of instruments employed. These principles were applied to produce from the simplest and smallest number of materials a means of illustrating the principles of optical instruments in general for the purpose of teaching in schools. Particulars are given regarding a considerable number of these. R. S. R.

2661. Misapplications of the Law of Errors and the Intrinsic Error in Focometry. T. Smith. *Phys. Soc., Proc.* 40. *pp.* 159–165; *Disc.*, 166, *June*, 1928.

In some physical measurements the uncertainty due to a single cause is not infinitesimal, and the precision of the mean of a large number of observations given by the law of errors is not then physically insignificant. An increase in the accuracy of single observations and not an increase in their number is then most important. An example is afforded in attempts to identify the position of an optical image. According to geometrical optics, this lies in a definite surface; but owing to the physical properties of light, this surface cannot be identified experimentally. The use of a double cyclindrical lens as a means of limiting more narrowly the space in which this surface lies is discussed. Modifications in the experimental conditions will enable the uncertainty attributable to the structure of light itself to be reduced to a negligible magnitude. In the *Discussion*, **L. C. Martin** referred to the applications of the above in ultra-violet microscopy and also to a paper by Beuch in which these considerations were discussed. R. S. R.

2662. Standardisation of Microscope Construction. C. John. *Zeits. f. Instrumentenk.* 48. *pp.* 292–299, *June*, 1928.

Describes the many variations between German microscopes of different manufacture, both from the mechanical and the optical aspects. Tables showing the differences in the optical systems are given in full. Suggestions for three standard types of microscopes which would fill all requirements are also made. R. C. F.

2663. New Internal-Focussing Instrument. W. H. Connell. *Journ. Sci. Instruments*, 5. *pp.* 195–198, *June*, 1928.

Particulars are given of a new type of surveying instrument in which the telescope is of constant length, has a negligible stadia constant, and is constructed on the lines of the internal-focussing type. Diagrams and figures illustrate the action and mounting of the instrument. The advantages claimed are (1) with the constant length the telescope can be hermetically sealed and dust and moisture are thus excluded; (2) the focussing of near objects does not appreciably disturb the balance of the telescope, since the focussing lens is situated between the object glass and the eyepiece; and (3) the constant length of the telescope and the simple nature of the focussing device render possible a greatly improved mechanical design which ensures the focussing lens moving truly along the optic axis. Thus collimation errors of practical importance are non-existent. The advantages of robust and great telescope power are retained, while dimensions and weights have been considerably reduced. R. S. R.

2664. Modern Photographic Telescopes and the New Astronomical Telescope. Part I. The Fixed Universal Telescope. G. W. Ritchey. *Roy. Astron. Soc. Canada, J.* 22. *pp.* 159–177, *May–June*, 1927.

Details are supplied of the fixed universal type of telescope devised when developing the types employed in America. It is claimed for this type of reflecting telescope that (1) the convenience, comfort and safety of the observers is perfect for all telescope sizes; (2) all refinements for visual, photographic, spectrographic and physical laboratory observations can be carried out under the most perfect laboratory conditions and used interchangeably; (3) all known useful forms of reflecting telescope can be used interchangeably as desired; (4) in long-exposure photography, direct and spectrographic, all the mirrors in use, excepting only the cœlostat plane mirror, lie in unchanging position throughout the exposure; (5) there is extreme smoothness of rotation and a very high degree of stability and alignment of all parts, optical and other, which is essential for the highest attainable perfection of astronomical photography. Criticisms are answered regarding the change of shape of the mirrors, the loss of light by reflection, the relatively small range of declination, and the fact that only one combination of mirrors and accessories is available for use at one time. For the last the author considers this no disadvantage, because if atmospheric definition alters an interchange can be effected in four minutes. [See also Abstract 309 (1928).] R. S. R.

2665. Solid Dipleidoscope Prisms. C. V. Boys. *Roy. Soc., Proc.* 119. *pp.* 489–505, *July* 4, 1928.

This very complete descriptive paper commences with an account of Bloxam's hollow prism and its use. §§ 2, 3 and 4 then deal with the solid, polarising and squat prisms respectively. § 5 is devoted to the testing of pyramidal error and § 6 to Fresnel's equations. § 7 describe the window transit instrument. § 8 discusses the improvement of astronomical instruments by the use of solid dipleidoscope prisms, whilst the final § 9 considers the prismatic astrolabe. The paper is well illustrated by diagrams.

H. H. Ho.

2666. Determination of the Velocity of Light. N. Deisch. *J.O.S.A. and R.S.I.* 16. *pp.* 272–275, *April*, 1928.

In the method suggested it is sought to avoid the limitations inherent in the use of a mechanical device such as a rotating multi-sectored disc for interrupting or modulating the beam by employing an electro-optic modulator or a pair of electro-optic modulators coordinately energised from the same oscillating circuit. The advantages claimed are (1) the pulsating beam can be simply generated; (2) its frequency can be rigorously controlled through the use of a calibrated piezoelectric resonator; (3) much higher frequencies can be obtained; (4) the Tyndall glow along the path of the beam would be materially reduced. The chief difficulty would be to secure a return beam of ample brilliance. Further practical notes are given. T. B.

2667. Demonstration of "Die Rastermethode" (Detection of Spherical Aberration by Means of Shadows in Astigmatic Beams). J. E. Calthrop. *Phys. Soc., Proc.* 40. *p.* 226, *June*, 1928.

This method, which has been applied recently by Jentzsch [see Abstract 1237 (1928)] and Schulz [see Abstract 1238 (1928)] to the measurement of the spherical aberration of lenses, consists in forming a real image of a small source, such as a pointolite or carbon-arc lamp, and inserting a grating in the neighbourhood of the image. The effect is viewed on a distant screen, and owing to the fact that the rays come from a caustic curve, they produce a shadow which is a distorted image of the grating. From measurements of the distortion it is possible to find the spherical aberration of the lens. The effects for a single line object were known to Silvanus Thompson in 1903, and a theoretical treatment was also given by Bennett in a paper entitled "Notes on Non-Homocentric Pencils and Shadows Produced in Them. Part I. The Standard Astigmatic Pencil" [see Abstract 1952 (1904)]. On the present occasion the curious shadows produced by lines, gratings and gauzes were demonstrated, and the differences between a corrected and uncorrected lens were illustrated. AUTHOR.

2668. Mechanism of Chemical Change. Part I. Promotion and Arrest of the Mutarotation of Tetra-Acetylglucose in Ethyl Acetate. T. M. Lowry and G. G. Owen. *Roy. Soc., Proc.* 119. *pp.* 505–522, *July* 4, 1928.

By making use of an ignited silica flask, the authors have prepared solutions of tetra-acetylglucose in dry ethyl acetate which were sufficiently pure to show no change of rotatory power during a period of several hours. Whilst the addition of a drop of water to such a solution does not suffice to initiate mutarotation, a rapid change is induced when a drop of dilute acid or alkali is added; the mutarotation curves are, however, inflected instead of unimolecular, as if the action had been resolved into two consecutive stages. Since the action of alkali was the same when the polarimeter tube was rinsed with a solvent and refilled with a second sample of the clean dry solution, it appears possible that these inflected mutarotation curves are characteristic of surface action, whereas the normal unimolecular curves are developed by homogeneous catalysis. H. H. Ho.

2669. Optical Activity and the Polarity of Substituent Groups. Part IX. Menthyl Esters of Methoxynaphthoic and of Diphenyl 2-Carboxylic Acids. E. Bretscher, H. G. Rule and J. Spence. *Chem. Soc., J. pp.* 1493–1504, *June*, 1928.

The influence of the methoxyl group on the rotatory power of the menthyl naphthoates has been examined and found to be similar to that exerted in the case of methyl benzoate. T. M. L.

2670. Rotatory Dispersion of Solutions. R. Lucas. *Ann. de Physique*, 9. *pp.* 381–459, *May–June*, 1928.

The variations of the optical rotatory power of a compound with changes of temperature, solvent, concentration, etc., can be explained (i) following Biot and Arndtsen, by assuming the presence in varying proportions of different forms of fixed rotatory power; or (ii) following Landolt, by supposing that the rotatory power of a given form can vary progressively with changes in the physical conditions. The former hypothesis can be tested, and the minimum number of forms determined, by applying a law of mixtures to the experimental data, on the assumption that 2, 3, 4, etc., forms are present. Thus, if the rotatory powers of four solutions are observed for three wave-lengths, a determinant can be constructed which will vanish in the case of a ternary, but not of a quaternary, mixture. In the case of a binary mixture a similar determinant for two properties of three solutions will vanish. This method is applied first to tartaric acid in water and in aqueous solutions containing calcium chloride, urea, boric and sulphuric acids, and sodium tungstate and molybdate. The experimental data for seven wave-lengths can then be interpreted on the supposition that we are dealing with mixtures of *three* compounds of fixed rotatory power but in variable proportions. Similar results were obtained with methyl and ethyl tartrate at different temperatures and in different solvents. The three hypothetical forms of tartaric acid and its esters are explained by the presence of three favoured configurations when the two halves of the molecule undergo " free rotation " about the central double bond. Similar observations with camphor, which becomes lævorotatory in presence of sulphuric and phosphoric acids, can be interpreted on the hypothesis of *two* forms of the ketone, one dextrorotatory and the other lævorotatory. T. M. L.

2671. Anomalous Rotatory Dispersion from the Standpoint of the Drude Equation. C. E. Wood and S. D. Nicholas. *Chem. Soc., J. pp.* 1671–1696, *June*, 1928.

Data are given for the rotatory dispersion of a series of derivatives of methyl and ethyl tartrate, including determinations at a series of temperatures. Attention is directed to the fact that, in every case of anomalous rotatory dispersion in these closely related compounds, the inflexion and maximum are observed in positive rotations, and that the crossing of the axis is always from positive to negative as the wave-length is diminished. The authors attach great importance to the infra-red term in Drude's equation for the rotatory dispersion of quartz, and consider that a similar infra-red term plays an essential part in the anomalous rotatory dispersion of the tartaric esters; but since the experimental data do not require the use of such a term, its existence is still purely speculative. Curves are given, however, showing the effect of combining an infra-red term with one or two ultra-violet terms in Drude's equation. T. M. L.

2672. Rotatory Dispersion of Tartaric Esters: Intersections of Dispersion Curves and of Temperature-Rotation Curves. C. E. Wood and S. D. Nicholas. *Chem. Soc., J. pp.* 1696–1712, *June*, 1928.

Rotation-temperature curves are plotted for ethyl monoacetyl-*d*-tartrate and for ethyl diacetyltartrate, and tables are given showing the magnitude and the wave-length of the maximum rotation of these two compounds in comparison with similar data for methyl and ethyl tartrates. The intersection of dispersion curves and the envelope formed by a series of these curves are discussed. The temperature-rotation curves are considered in a similar way. T. M. L.

2673. Anomalous Rotatory Dispersion of Configuratively Related Compounds. C. E. Wood and S. D. Nicholas. *Chem. Soc., J. pp.* 1712–1727, *June*, 1928.

The view is expressed that the sign of the anomalous dispersion of a substance is an absolute guide to its relative configuration. T. M. L.

2674. Rotatory Dispersion of Optically Active Coordination Compounds. C. E. Wood and S. D. Nicholas. *Chem. Soc., J. pp.* 1727–1738, *June*, 1928.

Attempts are made to correlate the sign of the anomaly in optically-active coordination compounds with the algebraic sign of the hemihedrism of the crystals, as given by arbitrary crystallographic rules, but "no generalisation can be made at present." T. M. L.

2675. Improved Method of Ultra-Violet Polarimetry. Anomalous Rotary Dispersion of Sodium Tartrate. T. M. Lowry and M. A. Vernon. *Roy. Soc., Proc.* 119. *pp.* 706–709, *July* 4, 1928.

In Lowry's triple-field polarimeter method, using Foucault prisms, the visual selection of the particular wave-length at which the intensity is the same in the three fields is replaced by a photographic method based on densitometer measurements. By this means measurements of the rotation in the ultra-violet at least as accurate as those from visual observations in the central region of the visible spectrum are obtained. A study of the rotatory dispersion of sodium tartrate in the ultra-violet region showed small systematic deviations from Biot's law, indicating that the rotatory dispersion is complex. W. S. S.

2676. Light from Molecular Diffusion within a Liquid. J. Cabannes and P. Daure. *Comptes Rendus*, 186. *pp.* 1533–1534, *June* 4, 1928.

Raman found [see Abstracts 322 and 323 (1928)] on the one hand a change in wave-length and a broadening of the incident beam, on the other hand a new diffusion spectrum. The authors find no change in the wave-length; they find a broadening of the incident beam and also Raman's new diffusion spectrum, which they discuss.

A. Cotton (*ibid.*, *pp.* 1475–1476, *June* 4, 1928) compares the results with Wood's fluorescence and optic resonance (1908). A. D.

2677. Raman and Cabannes-Daure Effects. A. Bogros and Y. Rocard. *Comptes Rendus*, 186. *pp.* 1712–1713, *June* 18, 1928.

Only the coherent radiation scattered by a transparent body undergoes marked increase in intensity near the critical point and produces opalescence. An experimental study of the light scattered by an opalescent mixture of water and phenol indicates that the Raman rays are incoherent. Broadening and displacement of scattered radiation lines in opalescence (Cabannes-Daure effect) are not found for this mixture, and an explanation is advanced based on the distinction between coherent and incoherent radiation. W. S. S.

2678. Experimental Laws of the Raman Effect and Theories of Light. J. Cabannes. *Comptes Rendus*, 186. *pp.* 1714–1715, *June* 18, 1928.

For the Raman effect in benzene the experimental laws governing the frequencies of the scattered light are shown to require a quantum theory explanation. The scattered light contains, in addition to the incident frequency N, the frequencies $N - n_1$, $N - n_2$, etc., where n_1, n_2, etc., are characteristic of the structure of the scattering molecules. This is in accord with quantum theory, classical wave theory, on the other hand, requiring in addition the frequencies $N + n_1$, $N + n_2$, etc. W. S. S.

2679. Theory of the Scattering of Light in the Earth's Atmosphere. J. J. Tichanowsky. *Phys. Zeits.* 29. *pp.* 442–447, *July* 1, 1928.

The author refers to the results obtained in a previous paper [see Abstract 324 (1928)] and to the assumptions made there to simplify the calculations. In the present paper the intensity of the light reaching the earth's surface is calculated for primary, secondary, and for tertiary scattering, and consideration is also given with the sun on the horizon to light scattered by the sky and reaching the earth. A comparison of the calculated values with those observed for the purest air at Ai-Petri and Simferopol indicates quite good agreement for the amount of polarisation. R. S. R.

2680. New Interference Method of Measuring the Surface Area of Film Catalysts. Parts I and II. F. H. Constable. *Roy. Soc., Proc.* 119. *pp.* 196–213, *June* 1, 1928.

Part I. Theory.—The reason for this work is to improve the standardisation of the catalyst used in the form of a very thin metallic film supported by china clay in the study of gas reactions at high temperatures carried out in a closed vessel surrounded with melting ice. In the paper is discussed what is meant by the surface area of a catalyst, and a means is developed for a general method of evaluating the surface area by the application of the fact that according to spectroscopic measurements of the intensity and wave-length of the light reflected from oxidised metal surfaces interference is the main cause of production of colour sequences. [See also Abstract 1218 (1928).]

Part II. Nickel.—Method of Preparation of the Film and Apparatus for Activation and Study of the Surface Area.—Details are given for obtaining uniform deposits of nickel by electrodeposition from nickel baths of varying composition upon graphited china-clay rods, use being made of a microbalance, the weight of nickel deposited being checked by the performance of a blank experiment. The colour of the deposit varies with the bath. Activation and oxidation are carried out in a quartz tube, the apparatus being of special design. Measurements by the interference method of activation at the lowest possible temperature give the maximum area of the film per unit mass of nickel. The area on activation seems to pass through a minimum and then to rise. J. K.

2681. Refraction of de Broglie Waves by Crystal Gratings. E. E. Witmer and L. Rosenfeld. *Zeits. f. Phys.* 48. 7–8. *pp.* 530–540, 1928.

Discusses a de Broglie wave (light wave or electron wave) falling upon a crystal grating. This wave may be simply diffracted, or it may give rise to other waves by a photoelectric action or retardation, and these may be diffracted by the grating. For both cases the authors derive Duane's equations by two different methods. The photoelectrons, which are derived from the conductivity electrons, produce distinctive refraction phenomena which may possibly be experimentally verified. E. E. F. d'A.

2682. Photographic Reciprocity Failure in the Under-Exposure Region. C. E. Weinland. *J.O.S.A. and R.S.I.* 16. *pp.* 295–297, *May*, 1928.

Further work shows that under similar conditions the reciprocity failure likewise occurs to a far greater extent, while the amount of latent image is very small, than when the amount corresponds to a density well up on the time-scale characteristic curve. [See Abstract 623 (1928).]

A. D.

2683. Covering Power of Photographic Silver Deposits. Part I. S. E. Sheppard and A. Ballard. *Kodak Research Lab. Comm. No.* 338. *Frank. Inst., J.* 205. *pp.* 659–689, *May*, 1928. *Phot. J.* 68. *pp.* 354–366, *Aug.*, 1928.

The photometric constant for photographic plates has been found to be valid over a considerable range of density, when development has been taken almost to the limit. Different development times, however, result in changes in grain size, which would be expected to affect this constant. This paper gives the results obtained for various times of development, and for experiments on the determination of the quantity of silver in small areas. Owing to the smallness of this quantity, three methods were investigated, when it was found that the nephelometric determination of silver as silver bromide could be used down to comparatively small amounts of silver, but the error of 8 % was considered too high. The colorimetric determination of silver as colloid silver was found to be unsuitable, whilst the colorimetric determination of silver as silver sulphide was only possible down to 0·01 mg. of silver. A development of this last method, using a microcolorimeter gave a very fair degree of accuracy when determining 0·002 mg. of silver. The density, using diffuse light, was measured by a Martens photometer which had previously been calibrated against a Jones densitometer. The results indicate that the covering power decreases with time of development, but tends to increase with increased exposure, and further, that development is a pronounced topochemical reaction, according to the classification of Kohlschütter. Different emulsions may not give the same rapid fall in the photometric constant—in fact, results are given in which this decrease only became noticeable at fairly high densities. The covering power of " development fog " is found to be only one-fifth of the normal covering power. Finally, graphs indicating the characteristic curves are given, showing that, although they are of the usual form, the relations of a family of curves for different development times may be very different. R. C. F.

2684. Fibrous Structure of AgBr in Dry Plates. H. H. Meyer. *Ann. d. Physik*, 86. 3. *pp.* 325–352, *June* 30, 1928.

AgBr in dry plates has a fibrous structure, *i.e.*, the octahedron surfaces (111) of the AgBr crystals range themselves parallel to the plate. The distribution of the (100), (110) and (111) planes are recorded. The results are used for quantitative interpretation of the ring-system in AgBr powder, and on passing Röntgen rays directly through the dry plate. Pure gelatine superposed on a dry plate also takes up a fibrous structure. A. D.

2685. Halogen Silver Photochemistry. Part I. Gravimetric Determination of Surplus Silver in Photographic Materials. Part II. Destruction of Photographic Materials by Hydrogen Peroxide and Ammonium Sulphide. H. H. Schmidt and F. Pretschner. *Zeits. f. wiss. Phot.* 25. *pp.* 293–307, *June, and pp.* 354–362, *July,* 1928.

The first part describes the results obtained from a quantitative gravimetric method, by means of which it is possible not only to obtain results for the surplus silver and halogen ions, but also for the determination of the total quantity of silver and halogen. 1/30 *N* nitric acid was used as the destroying acid, because with this concentration no trouble from oxidation was observed. Dry plates being unsuitable, the results are principally for strips of emulsion [Emulsionsnudeln], but the residue after filtration was also experimented upon, using the same method. No real equivalence between the silver and halogen in the emulsions used could be found, there being always an excess of silver, even in emulsions originally containing halogen excess. This excess appears to be connected with the type of silver halide used, being high for silver chloride and low for silver iodide. No definite connection can be found between the excess quantity of silver and sensitivity, state of ripening and performance. Finally, the conclusions of previous authors, having regard to the present results, are discussed.

The second part deals with the action of acid, neutral and alkaline hydrogen peroxide, and ammoniacal ammonium sulphide on photographic layers. With hydrogen peroxide a destroying action occurs, this being a function of the hydrogen ion concentration. In acid solutions the action is the same as with the acid alone, the hydrogen peroxide helping the action of the acid. Neutral hydrogen peroxide very quickly destroys the gelatine, whilst the alkaline solution easily reduces the silver halide to metallic silver. The darkening of photographic layers by hydrogen peroxide is found to be a function of the sensitivity and not to be due to the capability of reduction by the solution. Suitable destruction is also obtained by the use of alkaline ammonium sulphide, whilst the brown coloration due to the alkali, disappears with both hydrogen peroxide and ammonium sulphide solutions. R. C. F.

2686. Herschel Effect at Low Wave-Lengths. Lüppo-Cramer. *Zeits. f. wiss. Phot.* 25. *pp.* 308–316, *June,* 1928.

The Herschel effect, previously considered to occur only with infra-red radiation, is shown to exist for all regions of the visible spectrum. With red and orange it occurs for all light intensities, whilst with yellow, green and blue illumination it is only apparent with low intensities. At the higher intensities of the light of these colours an increase in blackening actually occurs, apparently due to a second reversal of the image. The difference between the Herschel effect for all wave-lengths and solarisation is discussed from the point of view of the penetrative power of the particular light. With red light the difference is very marked, owing to the lack of penetration of such light. With blue light the difference is less marked, and is due to the fact that the bleaching occurs on the rising portion of the normal blackening curve. Finally, the influences of bromide acceptors on this bleaching in blue light are considered. R. C. F.

2687. Sterry Effect on AgCl. Lüppo-Cramer. *Zeits. f. wiss. Phot.* 25. *pp.* 316–319, *June*, 1928.

The Sterry effect is that AgBr positive papers and films give softer pictures if preliminarily bathed in potassium dichromate. The author has found this to apply to the deeper blackenings, hardly, if at all, to the weaker. He has found the same thing to apply to AgCl, not only with potassium dichromate 1 %, but also with potassium ferricyanide 0·2 %, potassium permanganate 0·1 %, quinone 1 %, cupric chloride 1 %, ferric chloride 1 %, and ammonium persulphate 1 %. Curves are given. The silver nuclei first adsorbed are difficult to dislodge; those subsequently added are more lightly held. A. D.

2688. Optical Sensitising of AgI. Lüppo-Cramer. *Zeits. f. wiss. Phot.* 25. *pp.* 320–324, *June*, 1928.

Criticises Baukloh's conclusions [see Abstract 1569 (1928)]. Gives a collection of data as to the action of different dye-stuffs on the sensitivity of AgI emulsion. Sensitisers for AgBr are desensitisers for AgI emulsion free from KI. A. D.

2689. Experimental Photochemistry. H. N. Ridyard and D. W. G. Style. *J. Phys. Chem.* 32. *pp.* 861–867, *June*, 1928.

Study of the reflection of the mercury lines by the mirror in the Hilger U.V. monochromatic illuminator, and of the reflection losses at the various quartz surfaces in this instrument. Aggregate transmissions are calculated. A. D.

2690. Chemical Action of Radiations. P. Villard. *Comptes Rendus.* 186. *pp.* 1669–1673, *June* 18, 1928.

Belliot's interpretation of various photographic phenomena [see Abstract 622 (1928)] are discussed in relation to the considerations advanced by the author [Abstract 1728 (1927)], who upholds his view of the constitution of the latent image. Belliot supposes that, on over-exposure, a certain number of molecules of silver bromide are reduced to the metallic state, producing direct blackening, such molecules losing their ability to serve as nuclei for the development. It is, however, almost certain that what is formed is a sub-bromide, which is easily recognisable by its extreme resistance towards reagents capable of causing the disappearance, in a few moments, of an image fully developed. Complete reduction is difficult to obtain, and it was, moreover, by exposing silver chloride to light that Poitevin prepared the sub-chloride used in his experiments. The available data are insufficient to furnish an explanation of the relation between solarisation and the slight accompanying blackening, but consideration of atomic levels indicates that a plate, solarised for one frequency, may not be for another which concerns a deeper level; thus solarisation appears to be relative. T. H. P.

2691. Neocyanine. Frances M. Hamer. *Chem. Soc., J. pp.* 1472–1478, *June*, 1928.

This paper describes methods of preparing the three dyes of the neocyanine type, and discusses their probable constitutions. R. C. F.

2692. Photoelectric Cell in Visual Spectrophotometer. L. H. Tardy. *Rev. d'Optique*, 7. *pp.* 189–195, *May*, 1928.

Description of a combination in which a photoelectric cell replaces the eye. The sensitiveness is increased tenfold. A. D.

2693. Measurement of Effective Wave-Lengths of Coloured Screens used in Photometry. G. Ribaud, S. Nikitine and J. Mendousse. *Rev. d'Optique*, 7. *pp.* 196–204, *May*, 1928.

Improved methods, leading to a precision of ± 10 Å. for temperatures 1300° C. and 2000° C. A. D.

2694. Visual Stellar Cat's-Eye Photometer. A. Danjon. *Comptes Rendus*, 186. *pp.* 1524–1526, *June* 4, 1928.

Deals briefly with the main causes of the low accuracy obtainable with the usual stellar photometer, and then gives a short description of a new type of visual photometer, using a cat's-eye diaphragm, with which a precision of 1 part in 100 can be obtained. R. C. F.

2695. Photometer Bench. J. F. Sutton. *Journ. Sci. Instruments*, 5. *pp.* 184–187, *June*, 1928.

The author reviews the various types of photometer benches on the market and criticises them from the point of view of accurate experimental work, pointing out the lack of features which are essential when making measurements with any degree of precision. The various essential adjustments and readings in obtaining a photometric comparison are enumerated and are followed by a list of the methods available for carrying out the adjustments. A design is then given of a photometer bench which incorporates all the above features and which has been found to be suitable for the accurate comparison of all kinds of lamps. AUTHOR.

2696. Investigation into the Beam from a Standard Lighthouse Lens. W. M. Hampton. *Optical Soc., Trans.* 29. *pp.* 101–132, 1927–1928.

The paper describes some factory tests carried out on the new apparatus for the Hartland Point lighthouse. The light distribution across the beam was measured, using a petroleum vapour lamp and a 3-kW cruciform electric lamp as the illuminant; in the former case the intensity of light was approximately constant across the centre of the beam, having a maximum value of 125,000 candles; in the latter case the maximum value was 2,000,000 candles, and there was a succession of light and dark beams as the main beam was traversed. The brightness of the lens relative to the brightness of the source was measured by screening off all except a very small aperture; the brightness was found to fall off rapidly as the outer refractors were reached, but was constant over the reflectors. Polar curves of the various illuminants are given, and also curves showing the effect of oil-pressure variation in a petroleum lamp, and voltage variation in an electric lamp; with the former there is a point of maximum efficiency at 40 lbs. per sq. inch, while with the latter the variation is negligible. The latter part of the paper deals theoretically with the beam from a Fresnel apparatus, in which the following points are treated: Divergence of a small pencil after refraction, intensity of the beam from Fresnel type refractors, transmission factor and relative brightness of the lenses, intensity of the beam from Fresnel type reflectors, and the distribution of light in the beam for different types of lamps. The theoretical relations obtained are found to give results in agreement with the tests. E. O. T.

2697. Measurement of the Brightness of Diffusing Surfaces. A. Blondel. *Comptes Rendus*, 186. *pp.* 1487–1491, *June* 4, 1928.

The measurement of the brightness of diffusing surfaces has never been very clearly understood, and this paper is intended to clear up the apparent difficulties of this special subject. Practical calculations relative to this brightness are simplified by the use of the c.g.s. photometric units, such units being carefully defined. These definitions are followed by a brief description of a secondary standard of brightness, developed by the author, together with methods of the calibration of this standard. A coefficient which is characteristic of the diffusing material used, and which is termed the brightness factor, is then discussed. It is shown that the normal brightness factor—that in which only conditions normal to the surface are considered—can be of practical importance. Finally, the direct method and the comparison method of measuring this normal brightness factor are described. R. C. F.

2698. Luxmeter as Brightness Meter. A. Blondel. *Comptes Rendus,* 186. *pp.* 1677–1680, *June* 18, 1928.

The method of using a luxmeter for the comparison of two brightnesses, one of which is known, is first briefly described. All portable photometers, however, can be used as brightness meters by the use of a diffusing screen for which the normal brightness factor is known. Most photometers have two diffusing screens, and the method of calibration for their use as brightness meters is next dealt with. Finally, the types of multipliers which can be used, together with any modifications they cause in the calibration, are discussed. R. C. F.

2699. Ageing of Mercury-Vapour Lamps. W. Meyn. *Zeits. f. wiss. Phot.* 25 *pp.* 345–354, *July,* 1928.

By means of a simple photometric method, which consisted of a comparison of the variations of the times of exposure to give similar blackening of the mercury spectrum lines for the burnt lamps when compared with a normal lamp, it was found that the absorption of light was connected with the number of hours of burning; also this absorption rapidly increased as the wave-length decreased. The cause of this absorption was shown to be due to a coloured quartz layer 0·1 mm. thick on the inner surface of the mercury-vapour lamps. R. C. F.

2700. Physical Optics. Report of the Progress Committee, 1926-1927. The New Quantum Mechanics. *J.O.S.A. and R.S.I.* 16. *pp.* 301–306, *May,* 1928.

The report provides a summary of the results obtained in this branch during the period under review. Among other subjects touched upon is the new interpretation of the quantum mechanics developed by Dirac and in a more or less equivalent form by Jordan, and which has removed much of the discrepancy between light-quanta and the wave theory of light. Reference is made to a number of spectroscopic computations, to calculations regarding collisions with hydrogen atoms and the scattering and excitation coefficients and to electronic conduction. R. S. R.

2701. Extension of the Irregular Doublet Law. M. Saha and P. K. Kichlu. *Indian Journ. Phys.* 2. *pp.* 319–342, *March,* 1928.

Full data of Millikan and Bowen's arithmetic progression rule (irregular doublet law in the optical region) have been collected and are arranged in twenty-three tables. The law has been extended to the case of complex spectra and shown to hold good. Predictions are made concerning certain spectra which are yet unknown. F. S.

2702. Regularities in the Spectra of Six-Valence Elements. D. S. Jog. *Indian Journ. Phys.* 2. *pp.* 343–344, *March,* 1928.

The considerations of Saha and Kichlu [see preceding Abstract] are applied to the spectra of O, F^+, Ne^{++}, and the lines corresponding to the transitions $3L_2M_1 - 3L_2M_2$ and $3L_2M_2 - 3L_2M_3$ are identified in published values. F. S.

2703. Spectrum of Ionised Sodium. K. Majumdar. *Indian Journ. Phys.* 2. *pp.* 345–354, *March,* 1928.

Schillinger's values for this spectrum have been analysed in the light of the irregular doublet law extension [see Abstract 2701 (1928)]. A table is given of the lines thus classified. F. S.

2704. Series Spectrum of Sodium, Na_{II}. I. S. Bowen. *Phys. Rev.* 31. *pp.* 967–968, *June,* 1928.

Seventy-four lines in the sodium spark spectrum are classified as combinations between twenty-three terms of Na_{II}. The ionisation potential of Na_{II} is fixed at $47 \cdot 0 \pm 0 \cdot 5$ volts. AUTHOR.

2705. Broadening of Spectral Lines. F. Rasetti. *Accad. Lincei. Atti,* 7. *pp.* 561–565, *April* 1, 1928.

Theory of broadening by resonance as between equal atoms, compared with the effect as between unequal atoms; relation of the results to undulatory theory. Experimental measurements. A. D,

2706. Precision Measurements in the Tin K-Series. J. Stenman. *Zeits. f. Phys.* 48. 5–6. *pp.* 349–357, 1928.

The K-series lines of tin are measured with the new type of Siegbahn spectrometer. The lines α_2, α_1, β_3, and β_1 were measured in the first and second orders, β_2 in the first order only. The refractive indices of calcspar are calculated for these wave-lengths, and the K-absorption constant of bromine measured. A. C. M.

2707. Active Nitrogen. Part V. Decay of the Nitrogen Afterglow. E. J. B. Willey. *Chem. Soc., J. pp.* 1620–1629, *June,* 1928.

Experiments on the decay of the nitrogen afterglow show that the reaction is kinetically of the fifth order between pressures of 2 and 8 mm. Application of the kinetic theory to observations on the life of the glow show that, if the reaction be actually bimolecular, the concentration of the glow-producing system, assumed to be atomic, is only 10^{-5} to 10^{-6} of the chemically-active nitrogen present in the same circumstances. Such discrepancy may be overcome by assuming the process to represent an initial slow ternary reaction, $2N + N_2 \rightarrow 2N_2$, followed by two rapid binary reactions. This theory accounts for the negative temperature-coefficient of the glow-decay, and is considered (1) to furnish evidence that the glow and chemical activity in nitrogen represent separate and very variable stages in the complex de-activation process of a high-level molecule first formed from atoms, and (*b*) to explain the existence of other varieties of chemically active nitrogen reported from time to time and also divergencies in the spectroscopic and chemical characteristics of the Rayleigh form of active nitrogen. T. H. P.

2708. Cinematographic Sketch of Electrically Exploded Wires. H. Nagaoka and T. Futagami. *Imp. Acad. Tokyo, Proc.* 4. *pp.* 198–200, *May,* 1928. *In English.*

In the present work the exploded wires are photographed on a film moving about an axis parallel to the wire instead of on films rotating in a plane at right angles to the line of sight. Cinematograms for copper and iron wires and for magnesium ribbon are given. [See also Abstract 694 (1927).] J. K.

2709. Hydrogen Lines in the Electric Arc. (Miss) M. Hanot. *Comptes Rendus*, 186. *pp*. 1716–1717, *June* 18, 1928.

Experimental determinations of the width of hydrogen lines were made using an arc between copper electrodes. The arc persists in hydrogen only for a few hundredths of a second, and an automatic restriking device was employed. As the arc current increases, the width of the hydrogen lines becomes greater, an effect which is related to the increased intensity of the intermolecular electric field. W. S. S.

2710. Theory of the Excitation of Spectra by Atomic Hydrogen. J. Kaplan. *Phys. Rev.* 31. *pp*. 997–1002, *June*, 1928.

An explanation is proposed for the results of Bonhoeffer and of Mohler on the excitation of spectra by atomic hydrogen. The theories advanced by these authors do not completely explain the experimental results. The theory presented here is based on the hypothesis that in a three-body collision two hydrogen atoms can be bound to form a molecule in any one of the vibration states of its normal electronic level. Use is made of the principle, used in collisions of the second kind, that the probability of excitation increases as the energy of the exciting body and the energy necessary for excitation approach each other. This is done by postulating that the probability of the excitation of the third body is greater the nearer the energy required is to the difference between the energy of recombination and the energy retained by the hydrogen molecule in one of its vibration states. The theory has been applied successfully to the excitation of Na, K, Cd, Zn, Cs and Mg by atomic hydrogen. The excitation of the 2537 line of mercury, which requires more energy than that available from recombination, is explained on the basis of Bonhoeffer's observations. AUTHOR.

2711. Existence of Intermetallic Compounds in the Vapour State. Spectra of the Alkali Metals and of their Alloys with Each Other. J. M. Walter and S. Barratt. *Roy. Soc., Proc.* 119. *pp*. 257–275, *June* 1, 1928.

The alkali metals, Li, Na, K, Rb and Cs, are found to form a complete series of binary molecules with each other in the vapour state, and at the boiling-point of the metals these molecules constitute 1–2 % of the total vapour. The spectra of these compounds are described, the band systems in general lying near the lines of the principal series of the constituent atoms; the molecules containing lithium are exceptions to this rule. In addition to the bands are narrow regions of continuous absorption which are typical of the absorption spectra of the molecules. It is suggested that these regions correspond to the continuous absorptions of the halogen molecules, and the heats of formation of the alkali metal molecules have been worked out on this basis. The vapour density of potassium has been redetermined by the Victor Meyer method and the proportion of the molecular form found not to exceed 5 %. H. H. Ho.

2712. Spark Spectrum of Copper. A. C. Menzies. *Roy. Soc., Proc.* 119. *pp*. 249–256, *June* 1, 1928.

The method previously described [see Abstract 925 (1928)] of obtaining spectrograms with one short exposure by fusing wires has now been extended to the use with a vacuum grating spectrograph. The copper spectrum has been thus investigated and the lines 1358·76, 1367·92 and 1472·38 Å. are allocated to $1^1S_0 - a^1P_1$, $1^1S_0 - a^1D_1^1$ and $1^1S_0 - a^3P_1$ respectively. Photographs of the spectrum of a copper-gold arc show that the Shenstone scheme of copper-spark terms is consistent with the gold-arc term scheme of McLennan and McLay. Some additional copper-spark terms which have been found are also listed. F. S.

2713. First Spark Spectrum of Palladium (PdII). A. G. Shenstone. *Phys. Rev.* 32. *pp.* 30–38, *July*, 1928.

An analysis of PdII is given which differs completely from the previous one made by McLennan and Smith [see Abstract 140 (1927)]. The terms found include $4d\,^2D(4d^9)$; $5s\,^{4\,\&\,2}F$, $^{4\,\&\,2}P$, ^2D, $^2G(4d^8 5s)$; all the related triads from the structure $4d^8 5p$; $6s\,^{4\,\&\,2}F$, $^4P_3$, $^2G_5$, $(4d^8 6s)$; and fragments of terms due to $4d^8 5d$. Zeeman effects of the majority of the lines have been measured and approximate *g*-values found for the low and middle sets of terms. The *g*-values depart largely from Landé's values, as do also the term intervals. Evidence is given that the term predicted by theory, $5s\,^2S(4d^8 5s)$, is present, but it has not been fixed with respect to the other terms. The lowest term, $4d\,^2D$, gives lines in the vacuum region and was found by H. E. White, of Cornell University, from plates taken there. The ionisation potential is calculated from the $s\,^4F$ terms as 19·8 volts from $4d^9$ to $4d^8$. As in other spectra of this type, there is some indication in the limits of the component series that the Hund theory of limits is incorrect. AUTHOR.

2714. Tesla Luminescence Spectra of the Halogens. Part I. Iodine. S. S. Bhatnagar, D. L. Shrivastava, K. N. Mathur and R. K. Sharma. *Phil. Mag.* 5. *pp.* 1226–1240, *June*, 1928.

An electrodeless Tesla discharge was excited in a tube 30 cm. long provided with a quartz window and photographed with quartz spectrograph. The spectrum obtained had a continuous background from 4800 Å. to 2130 Å. with a number of superposed electronic emission bands. Four different systems have been located, of which one has been analysed. A brief discussion is given of the bands at 4800 Å. and 3440 Å., which have been called "electron affinity" bands. An attempt is also made to explain the continuous background. F. S.

2715. Excitation of the D-Lines by the Green Sodium Band. E. L. Kinsey. *Nature*, 121. *pp.* 904–905, *June* 9, 1928.

See Abstract 1599 (1928).

2716. Diffuse Molecular Spectra. Photochemical Decomposition of Ammonia. K. F. Bonhoeffer and L. Farkas. *Zeits. f. phys. Chem.* 134. 5–6. *pp.* 337–344, *June*, 1928.

Ultra-violet rays decompose hydrogen iodide [see Abstract 371 (1927); also *ibid.* 132. p. 235 (1928)] into atomic iodine and hydrogen, as is shown by the identification of the free atoms and the continuous character of the spectrum. A continuous absorption spectrum corresponds to a primary dissociation process, a band spectrum with discrete lines to a primary excitation. But Henri [Abstract 565 (1925)] has observed predissociation band spectra which show edge effects, but cannot be resolved into lines.

This type is found in complex molecules and also in ammonia [Henri; Leifson, Abstract 1583 (1926)]. The authors did not succeed in obtaining the emission spectrum of NH_3. When the gas was passed through a discharge tube at several mm. pressure, and the whole tube appeared grey-green, changes were observed to take place in the spectrum. At smaller vapour velocity and pressures of a few tenths of a millimetre ammonia bands appeared in a continuous spectrum (of hydrogen). Sparks or arcs between metal electrodes did not call forth phosphorescence. At ordinary temperature only 0·25 molecule of ammonia seems to be decomposed per quantum, possibly into NH_2+H_2, which recombine. Two kinds of photochemical decompositions should be distinguished. Direct or photolytic processes proper decompose the molecule without the interaction of external impacts; indirect processes excite the molecule, which is then decomposed by collision with another molecule. In the former, proper photolytic process the molecule may primarily be decomposed (I_2 in the continuum, IH), or the primarily excited molecule may be decomposed spontaneously without radiating (NH_3, predissociation spectrum). H. B.

2717. Absorption Spectra of Hydroquinolphthalein and Hydroquinolsulfonephthalein. C. V. Shapiro. *Am. Chem. Soc., J.* 50. *pp.* 1772–1778, *June,* 1928.

The evidence from the study of the absorption spectra in neutral, acid and alkaline solutions provisionally confirms the deductions made from the chemical behaviour of these compounds, namely, that they can exist in the meta-quinoid state. Hydroquinolsulfonephthalein is also shown to have an inner salt structure. J. K.

2718. Resonance Line of the Iodine Atom and the Optical Dissociation of Iodine Molecules. L. A. Turner. *Phys. Rev.* 31. *pp.* 983–985, *June,* 1928.

The resonance line of the iodine atom is most probably that of wave-length 1830·4 Å., corresponding to a resonance potential of 6·75 volts. Light of that wave-length is absorbed by a cell containing iodine vapour more strongly when it is illuminated by concentrated light from a carbon arc than when it is not so illuminated. The increased absorption is attributed to iodine atoms produced by the illumination, in accord with Franck's theory of optical dissociation [see Abstract 1940 (1926)]. AUTHOR.

2719. Optically Excited Iodine Bands with Alternate Missing Lines. R. W. Wood and F. W. Loomis. *Phil. Mag.* 6. *pp.* 231–238, *July,* 1928.

The fluorescence was excited in a tube about 50 cm. long by means of four vertical Cooper-Hewitt glass mercury lamps, and photographs taken in the second order of a 6-in. plane grating with a lens of 3 metres focus. To elucidate part of the structure, a special grating was ruled with a specially bright third order. A comparison of lines of the (26, 1) band in absorption and fluorescence is given. The results are discussed from the standpoint of wave-mechanics and found to accord better with this than with the classical Bohr-Lenz theory. F. S.

2720. Spectrum of Gold Chloride. W. F. C. Ferguson. *Phys. Rev.* 31. *pp.* 969–972, *June,* 1928.

The spectrum of gold chloride vapour excited by streaming active nitrogen was photographed. It was found to consist of forty-three bands comprising, for each isotope of AuCl, two intermingled systems in the green region. All the bands are shaded towards the red. No other bands were found between λλ7000–2000. The band heads of each system were measured, and equations are given representing their positions. Agreement with theory was found for the isotopic displacement of the band heads due to the chlorine isotopes. The vibrational intensity distribution agrees with that theoretically expected from the observed relative values of the initial and final vibrational frequencies. Attempts to excite spectra of gold bromide and iodide in a similar manner were without success. AUTHOR.

2721. Stark Effect and Series Limits. H. P. Robertson and Jane M. Dewey. *Phys. Rev.* 31. *pp.* 973–982, *June*, 1928.

It is shown that the energy of a conditionally periodic orbit in a hydrogen-like atom under the influence of a homogeneous external field F must be less than $-(3/2)[e\mathrm{F}p\phi/m^{1/2}]^{2/3}$. Aperiodic orbits of less, as well as of greater, energy than this value can exist, and in one class of these the electron may approach the nucleus within distances comparable with the dimensions of periodic orbits. The lower limit of the energy of these orbits is approximately $-2e(e\mathrm{F})^{1/2}$. Since the energy of an aperiodic orbit can assume any one of a continuum of values, it is concluded that the line spectrum of such an atom must end at a point on the long wave-length side of the normal series limit, and that the continuous spectrum, arising from transitions involving an aperiodic orbit, may extend even further within the normal series limit. Application to the mean field in actual gases gives the position of the maximum of the continuous spectrum in good agreement with the observed values. Further experiments for checking the theory are described. AUTHORS.

2722. Electrical Excitation of Mercury-Vapour Fluorescence. S. Pieńkowski. *Comptes Rendus*, 186. *pp.* 1530–1532, *June* 4, 1928.

Mercury vapour, during the passage of an electric current, contains atoms in different states of excitation. This paper gives a short *résumé* of the results obtained from a study of the fluorescence of the vapour in this condition. The vapour is formed by external heating, and the well-known green fluorescence is obtained with a very dense vapour. If the density of the vapour be decreased, this fluorescence disappears, but with a weaker current, a bluish-green fluorescence can be obtained. The latter fluorescence is excited mainly by the line 4358 ($2^3\mathrm{S} - 2^3\mathrm{P}_1$), whilst the line 5461 ($2^3\mathrm{S} - 2^3\mathrm{P}_2$) has no effect. This means that the passage of the current produces the change in the atom from the normal to the $2^3\mathrm{P}_1$ state. R. C. F.

2723. Fluorescence of Mercury Vapour. R. W. Wood and V. Voss. *Roy. Soc., Proc.* 119. *pp.* 698–706, *July* 4, 1928.

It is shown that practically all of the stronger arc lines of the mercury atom are emitted by mercury vapour when excited by the light of the aluminium spark, which can be absorbed only by the mercury molecule (band absorption). The line intensities vary as the square of that of the exciting light. Effects of superheating the vapour on the intensities of the various lines and bands have been investigated, as well as the development of other bands and lines due to the presence of impurities, and caused probably by collisions with excited molecules. The observed fact that under certain conditions mercury vapour exhibits fluorescence only when undergoing distillation is shown to be attributable to the presence of water vapour, which destroys the fluorescence in stagnant vapour, but which is of course absent from the freshly formed vapour in the distillation experiment. W. S. S.

2724. Zeeman Pattern of the Hyperfine Structure Lines of the Resonance Line of Mercury. W. A. MacNair. *Phys. Rev.* 31. *pp.* 986–996, *June*, 1928.

The Zeeman pattern of each of the five hyperfine structure lines of $\lambda 2537$ ($1^1S_0 - 2^3P_1$), the resonance line of mercury, has been obtained in fields from 0 to 7 kilogauss. With certain very significant exceptions each one forms a 3/2 normal Zeeman triplet, and is independent of its neighbours, that is, no Paschen-Back effect appears. The parallel branch of one of the five lines actually shifts its position with changes in the field strength. Each one of the five lines has two 3/2 normal perpendicular branches. In addition three of them have one or two extra perpendicular components. Attention is called to the relations between these results and experiments on the *polarisation of mercury resonance radiation*. One is warned against any theoretical explanation of the latter phenomena until more is known of the hyperfine structure of the energy levels of mercury. A quartz Lummer-Gehrcke plate was used for the analysis. One rather unusual method of employing it is described. [See also Abstract 1287 (1928).] AUTHOR.

2725. Influence of the Magnetic Field on the Bands of the Third Positive Nitrogen Group. B. Pogány and R. Schmid. *Zeits. f. Phys.* 49. 3–4. *pp.* 162–166, 1928.

By transversal observation and moderate dispersion the magnetic doublet splitting-up of the bands of the third positive nitrogen group was observed. Reproduction of a photograph and tables of wave numbers are given. J. J. S.

2726. New Relationship in the Intensity Ratios of the Principle Doublets Series of Alkalies. S. Sambursky. *Zeits. f. Phys.* 49. 9–10. *pp.* 731–739, 1928.

The intensity ratios for several principle doublet series of Cs, Rb, K, and Na are measured using a 440-volt carbon arc the lower carbon of which was filled with the chloride of the corresponding alkali, whilst the optical apparatus consisted of a Hilger quartz spectrograph. The results showed clearly that the summation rule was not valid and did not apply. An attempt was, therefore, made to find another law which fitted the case. The range of the intensity ratios from the first to the fifteenth member was given by the formula $J_1/J_2 = c \, . \, n^a_{eff}$. The intensity ratio increases up to a reversal or maximum point according to a definite power of the quantum number, the exponent of which (a) depends on the nature of the metal under test. c is a constant which can be estimated for each alkali. The formula is empirical but gives the reversal point with great precision. The exponent (a) increases up to the reversal point with the atomic number. The value of (a) for the different materials above mentioned is: Cs, up to 2·5; Rb, up to 0·91; K, up to 0·26; and Na, up to 0·14. The consequences of this law are discussed and further work outlined. S. G. B.

2727. Multiplets in the CoII Spectrum. W. F. Meggers. *Washington Acad. Sci., J.* 18. *pp.* 325–330, *June* 19, 1928.

The Co spectrum between 2150 and 5000 Å. has been remeasured, several classes of spark recognised and a number of multiplets of CoII discovered. A table of these is given. The lines between 3353 Å. and 3621 Å. suggested a search for CoII lines in the solar spectrum, and a table of these is also included. F. S.

2728. Multiplet Separations for Equivalent Electrons and the **Röntgen Doublet Law. S. Goudsmit.** *Phys. Rev.* 31. *pp.* 946–959, *June*, 1928.

Expressions are derived for the separation of multiplets arising from configurations of equivalent electrons. It is explained why the Röntgen doublets obey the Sommerfeld formula, although this formula was derived formerly for a single electron only. The separations of more complicated multiplets are proved to be connected also with the Sommerfeld formula. According to Landé the multiplet separations can be characterised by factors, designated by Γ, which give the displacement of each level from the centre of gravity of the whole multiple level. The properties of these Γ factors are studied in this paper. They are quite analogous to the well-known properties of the magnetic separation factors, *g*, introduced by Landé for the explanation of the Zeeman effect. It is pointed out that there is a Γ sum rule, corresponding to the well-known *g* sum rule, stating that, for given quantum numbers of the electrons, the sum of the Γ values belonging to a certain total moment *j* is a constant, independent of the type of coupling of the electrons. This rule is important especially because it makes it possible to obtain expressions for the multiplet separations in general cases. [See next Abstract.] AUTHOR.

2729. Multiplet Separations. S. Goudsmit and C. J. Humphreys. *Phys. Rev.* 31. *pp.* 960–966, *June*, 1928.

Formulæ for the separations of normal multiplets, arising from general configurations, are derived by reasoning from the fundamental assumption that they are due to the interaction energy between spin and orbital magnetism of the electrons. The separations are known for multiplets arising from groups of equivalent electrons, from considerations given in the preceding paper. It is shown in this investigation, by a simple treatment of the vector model, that the interaction energy for other configurations may be found in terms of that of the equivalent group and the interaction energy of the electron or group of electrons added, provided the quantum vectors of the original configuration remain unchanged. Our treatment applies only to multiplets showing reasonably close agreement with the interval rule, and which are therefore accounted for by the Russel-Saunders coupling. Examples given for illustration are taken from data on Fe and O+. Calculated results indicate the validity of our formulæ to the extent permitted by agreement of data with the interval rule. [See preceding Abstract.] AUTHORS.

2730. Photochemical Action of Röntgen Rays of Different Wave-Lengths. R. Glocker and O. Risse. *Zeits. f. Phys.* 48. 11–12. *pp.* 845–851, 1928.

In this paper the results are given for the decomposition of H_2O_2

and $K_2S_2O_8$ by wave-lengths varying from 0·19 to 1·54 Å., and the necessary energy of the rays is determined. Reference is made to earlier papers [see Abstracts 2934 (1927) and 1628 (1928) wherein it was shown that a relationship exists between the wave-length of Röntgen rays and certain photochemical changes such as photographic darkening, fluorescence and conductivity changes. The present work is the result of an enquiry as to whether such a relationship exists for other photochemical reactions. J. K.

2731. Laws of the Physical and Chemical Action of X-Rays. R. Glocker. *Zeits. f. tech. Phys.* 9. 6. *pp.* 201–207, *June*, 1928.

Compares the relation between the X-ray wave-length and ionisation, photographic action, production of fluorescent light and different photochemical reactions produced by it, and shows that in all cases the action depends on the amount of X-ray energy converted into photoelectrons and Compton electrons; it is thus possible to calculate the sensitivity of any measuring apparatus for X-rays of different wave-lengths from its chemical composition and from physical constants. The photochemical law of equivalence which holds for light does not do so for all X-ray actions, since the number of secondary electrons liberated is far greater than that of the primary electrons liberated when quanta of X-ray energy are absorbed. When photochemical X-ray reactions take place in solutions, not only the electrons liberated in the molecules of the solute, but all those liberated in the solvent take part in the chemical transformation. H. N. A.

2732. Multiple Ionisation and Absorption of X-Rays. F. K. Richtmyer. *Phil. Mag.* 6. *pp.* 64–88, *July*, 1928.

Raises the question whether there are discontinuities in X-ray absorption spectra corresponding to the so-called " spark " lines, which are analogous to the K, L discontinuities corresponding to the diagram lines. The experimental evidence bearing on the nature of the spark lines is reviewed, and it appears that the processes which give rise to them are secondary ones, so that that it is not probable that evidence as to the origin of these lines can be found in absorption spectra. In any case the lines are so weak that existing absorption observations are not sufficiently precise as to show absorption discontinuities connected with them. When the square root of the difference of frequency between a spark line and its parent line is plotted against atomic number a straight line (Moseley graph) is obtained; it is, therefore, suggested that spark lines may originate in two-electron transfers. For instance an atom has been doubly ionised, and lacks a K electron and an M electron; an electron is transferred from L_{II} to K, and simultaneously another is transferred from an optical orbit O to M, it is shown that a single quantum corresponding to $K\alpha_4$ might be emitted. The error due to slit width in X-ray absorption measurements is discussed; it is shown that with some of the widths used errors of several per cent. may occur near 0·3 Å. H. N. A.

2733. X-Ray Spectroscopy of Beaten Metal Sheets. J. J. Trillat. *Comptes Rendus*, 186. *pp.* 1535–1536, *June* 4, 1928.

An outline is given of an X-ray study of the effect of cold beating (or hammering) on the structure of thin metal sheets. The method has been applied also to an examination of the markings of beaten steel sheet.

The X-ray observations indicate orientation effects due to the beating, these effects being particularly intense in regions of greatest curvature. The effect of beating is also to reduce the size of the grains. The state of internal stress is also indicated by distortions and deformations of the reticular planes. A. B. W.

2734. Focus of a Gas-Filled X-Ray Tube. R. E. Clay. *Phys. Soc., Proc.* 40. *pp.* 221–223; *Disc.*, 223, *June*, 1928.

The importance of obtaining a sharp focus in an X-ray tube used for crystal analysis is emphasised. Pinhole photographs of the focus obtained with various radii of curvature of the kathode and various distances from the antikathode are discussed and the conclusion drawn that with the tubes of the type considered, a radius of about 2 cm. and a distance of 3 or 4 cm. are the best conditions. AUTHOR.

2735. Relative Intensities of X-Ray Lines in the L-Spectrum of Uranium. S. K. Allison. *Phys. Rev.* 32. *pp.* 1–11, *July*, 1928.

The relative intensities of 17 lines in the L-spectrum of uranium have been measured as a continuation of the work previously reported on thorium [see Abstract 115 (1928)]. Changes in the apparatus are described which reduce the magnitude of the corrections to be applied. The variation of the intensity of ULa_1 with voltage has been studied and may be closely represented by $I = C(V - V_0)^{1\cdot 8}$, and with less accuracy by a function $I = C((V - V_0)/V_0 - \log(V/V_0))$, developed by Rosseland. The observed results at 52·8 kV have been extrapolated to the relative intensities at voltages very much greater than the critical voltages. Important results are: (1) The lines $\gamma_3\gamma_2$ and $\beta_3\beta_4$, known in other elements to deviate from the sum rule predictions, have equal intensities in uranium, although a ratio 2 : 1 is predicted. (2) The lines $\gamma_6\beta_5$ are 17 times more intense in uranium than in tungsten, due presumably to the filling of the 5_3 orbits in the intervening elements. (3) The lines $\gamma_4\gamma_5$ which are present in the tungsten spectrum are absent in the uranium and thorium spectra. It is shown that if Rosseland's function (above) holds for electron collisions in which the velocity of the impinging electron is great compared to the velocities of the electrons in the atom, the relative intensities of lines of a multiplet under these conditions are equal to the product of the transition probability by the statistical weight of the initial state with only a slight correction. The results are:—

	·	α_2.	α_1.	η.	β_6.	β_2.	β_4.	β_7.	β_5.
Rel. Int. at 52·8 kV ..	2·4	11	100	0·83	1·6	28	3·2	0·4	6·4
Rel. Int. at high voltage	2·4	11	100	1·0	1·6	28	4·1	0·4	6·4

	β_1.	β_3.	γ_5.	γ_1.	γ_2.	γ_3.	γ_6.	γ_4.
Rel. Int. at 52·8 kV........	40·5	3·3	0	9·7	1·1	1·1	1·8	0
Rel. Int. at high voltage	49·4	4·2	0	12	1·5	1·4	2·2	0

AUTHOR.

2736. New Measurements of the L-Series of X-Ray Spectra. H. Brauns. *Zeits. f. wiss. Phot.* 25. *pp.* 325–344, *July*, 1928.

A general description of a number of the usual X-ray spectrographic methods concluding with a description of a new spectrograph built by the author for accurate measurement using the Bragg method. The results of a series of measurements of the L-series of Zn, Ta, W, Pl, W and Ur are given and compared with those of previous experimenters. It is shown that the results of the Bragg method for these lines are in agreement with those obtained by other methods such as the Seemann wedge method if account is taken of certain inherent errors. W. V. M.

2737. Sources of Error in Precision Wave-Length Measurements of X-Rays. H. Iwata. *Zeits. f. Phys.* 49. 3–4. *pp.* 217–227, 1928.

Experiments have been made to obtain the wave-lengths of certain lines, *e.g.*, W–Lβ_1, W–Lβ_2 and Pt–Lα_1 in terms of the CuKα_1 (1473·354 Å.) using both the Seemann wedge method and Bragg's rotating crystal method. The accuracy of the two methods is compared, and it is shown that greater accuracy is normally obtained by the first method. W–Lα_1(λ = 1473·35 Å.) and Ro . Kα_1(λ = 708·05 Å.) are suggested as secondary standards for wave-length measurements. W. V. M.

2738. Scattering of X-Rays from Gases. C. S. Barrett. *Phys. Rev.* 32. *pp.* 22–29, *July*, 1928.

Intensity of the scattering of molybdenum X-rays from carbon dioxide, argon, oxygen, nitrogen, helium, and hydrogen at scattering angles from 20° to 155°. All except hydrogen show excess scattering (with helium it may, however, be due to nitrogen present as an impurity); the excess scattering extends to larger angles from the primary beam as the atomic number of the gas increases and as the wave-length increases. This excess scattering appears to be mostly, if not wholly, due to interference arising within the atom. Destructive interference is prominent with argon, and seems probable (though it is very weak) with oxygen, carbon dioxide, and nitrogen. Mark and Schocken's results, which indicated scattering by gases follows the $(1 + \cos^2\theta)$ law, are not confirmed. Hydrogen follows within experimental error the quantum theory prediction of Breit, Dirac, Gordon, and Waller. Even when the K_a rays of molybdenum are used the scattering from hydrogen does not show the irregularities predicted by Debye's interference theory. AUTHOR.

2739. Photoelectric Properties of Some Metals in the Soft X-Ray Region. Letitia P. Davies. *Roy. Soc., Proc.* 119. *pp.* 543–552, *July* 4, 1928.

In a paper by Richardson and Robertson [see Abstract 2932 (1927)] dealing with the absolute values of the efficiencies of various substances as soft X-ray producers, the values obtained for carbon, iron, nickel and tungsten differ considerably from those obtained earlier by Richardson and Chalklin. It was suggested that the difference between the two sets of results might be due to the fact that Richardson and Chalklin used a copper photoelectric detector, while Richardson and Robertson used a nickel one. This question has been investigated by the present author, the paper consisting largely of a description of the experimental technique employed. It appears that the large differences between the two sets of results cannot be due to the difference in the photoelectric plate.

W. V. M.

2740. Critical Absorption Photometer for the Study of the Compton Effect. C. V. Raman and C. M. Sogani. *Roy. Soc., Proc.* 119. *pp.* 526–530, *July* 4, 1928.

The scattered X-rays are passed through an absorber and recorded on a photographic plate, the wave-length of the X-rays and the particular absorber being chosen so that the wave-length of the unmodified ray is slightly smaller and the wave-length of the Compton ray, at some convenient scatter angle, slightly greater than the critical K-absorption limit of the absorber. The density of the photographic impression changes abruptly as the scatter angle varies in the neighbourhood of the angle at which the Compton ray wave-length equals that of the K-absorption limit. The proportion of modified to unmodified scattered radiation is also investigated, using as standard of comparison a steel wedge placed in the scattered beam by the side of the absorber. The known features of the Compton effect are unambiguously indicated. W. S. S.

RADIOACTIVITY.

2741. Rutherford's Theory. G. Gentile. *Accad. Lincei, Atti,* 7. *pp.* 346–349, *Feb.* 19, 1928.

In connection with Rutherford's theory of the constitution of the nucleus [see Abstract 3147 (1927)] the author points out difficulties arising from the largeness of the quantic numbers, which lead to impossibly short lives for the radioactive elements. A. D.

2742. Visual Demonstration of H-Rays. H. Pettersson. *Zeits. f. Phys.* 48. 11–12. *pp.* 795–798, 1928.

In the method first described the Wilson-Shimizu apparatus is used, the source of H-rays consisting of a short glass capillary tube with a thin wall, the air equivalent of which is over 4 cm., so that no α-particles from a minute polonium preparation placed in the axis of the tube can pass through; the inside of the tube is coated with a thin layer of paraffin, the H-rays from which pass through the tube wall into the cloud chamber of the Shimizu apparatus, in the centre of which the tube is fixed. The device has been employed to demonstrate the "natural" H-rays to audiences. In some cases "nicked" paths have been observed. An H-spinthariscope is also described, in which a somewhat similar preparation is employed to project H-rays on to a zinc sulphide screen on which the resulting scintillations are observed; by moving a handle the H-ray source can be removed from beneath the screen, and a source of α-rays substituted, so that the difference in the brightness of the scintillations from the two sources can be observed. H. N. A.

2743. Action of the Geiger Counter. L. F. Curtiss. *Phys. Rev.* 31. *pp.* 1060–1071, *June,* 1928.

Experiments performed with a Geiger point counter show that when the point is negative the sensitive surface is on the point, and not on the inner wall of the chamber, as suggested by Kutzner [see Abstract 2118 (1924)]. It is further shown that this sensitive surface can only be obtained when the point has been treated in a way which makes it *catalytic.* Such catalysts as iron oxide, copper oxide and platinum black work very well. Their activity is destroyed by catalytic "poisons" such as Hg, SO_2 and H_2S. The experiments indicate that the gas layer usually adsorbed by such catalytic surfaces plays an important rôle in the action of the counter. The gas layer is demonstrated quite positively by observing the point during operation through a microscope in a darkened room. With a vacuum tube amplifier connected to the counter to actuate a relay at each count, a faint flush on the surface of the point is readily discernible for each click of the relay. When the point is positive no special treatment is needed to make it work. This is shown to be consistent with the explanation offered for the action of the chamber when the point is negative. AUTHOR.

2744. Source of Penetrating Radiation. W. Perschke. *Zeits. f. Phys.* 49. 9–10. *pp.* 740–741, 1928.

An attempt to explain the creation of penetrating radiation by the formation of helium atoms from hydrogen. The creation of helium is carried out beyond the earth's atmosphere in the neighbourhood of newly created worlds or stellar bodies. The consequences of the formation of 4 hydrogen atoms into helium are discussed fully. S. G. B.

2745. Preparation of Polonium from Radium Compounds and Active Lead Salts. Elisabeth Rona. *Akad. Wiss. Wien, Ber.* 137. 2*a*. 3–4. *pp.* 227–234, 1928.

By the addition of copper chloride to a strong radium preparation and subsequent precipitation with hydrogen sulphide, RaD and polonium may be obtained in a pure state. The method is adapted for the separation of RaD from RaE and RaF. Polonium may also be separated from active lead salts by shaking the solution with silver leaf. The amount separating on gold and platinum foil under identical experimental conditions is only about 5 % of that separating on silver. A higher yield was obtained by the use of colloidal silver, but it was not found possible to separate the polonium from the silver. L. L. B.

2746. A Gaseous Helide of Radium Active Deposit. D. M. Morrison. *Cambridge Phil. Soc., Proc.* 24. *pp.* 268–275, *April*, 1928.

On the hypothesis that the helium atom can exist in a hydrogen-like form in which one electron is relatively far removed from the nucleus with respect to the other, experiments were carried out with a view to determine whether or not helium could be obtained in the form of a compound similar to certain known hydrides. Positive results were got. A gaseous compound is found when excited helium is passed over a strong source of the active deposit of radium. That the effect observed was due to the presence of a gaseous radioactive helide and not to radium emanation or solid particles in suspension was proved. J. J. S.

2747. New Method of Determination of the Volume of 1 Curie Radon. L. Wertenstein. *Phil. Mag.* 6. *pp.* 17–33, *July*, 1928.

The method adopted for the quantitative analysis was based on the properties of highly rarefied gases. The coefficient of external friction of a highly rarefied pure gas is proportional to its pressure and to the square root of its molecular weight, and of a mixture of two gases to the sum of the products of the pressure and the square root of the molecular weight of each constituent. If purified radon is condensed at the temperature of liquid air, the only gas which condenses with it is CO_2, so that when the other impurities are pumped off, and the liquid air is removed, the apparatus is filled with a mixture of radon and CO_2. The pressure is determined with a Knudsen gauge, and the coefficient of friction with a quartz fibre gauge. The following values of V_0, the volume of 1 Curie of radon at standard temperature and pressure, were obtained: 6·15, 6·41, 6·26, 6·33 and $6 \cdot 8 \times 10^{-4}$ c.c. Difficulty was experienced with gases given out by the glass of the apparatus when bombarded with α-rays. Experiments were also made by the usual capillary tube method, and results very similar to those of Rutherford were obtained: $V_0 = 6 \cdot 4 \times 10^{-4}$ c.c. The "clear-up" action in the capillary tube is discussed. H. N. A.

2748. Disintegration of Carbon by α-Rays. H. Pettersson. *Akad. Wiss. Wien, Ber.* 137. 2*a*. 1–2. *pp*. 1–6, 1928.

Polonium α-particles, the range of which was reduced by absorption, were employed and the retrograde method. The number of scintillations produced with graphite showed a distinct diminution when the range of the α-particles fell from a mean value of 3 cm. to one of 2·4 cm. When the range was reduced to 2 cm. the number of particles produced by disintegration observed was of the same magnitude as the scintillations without the polonium preparation. Apparently, then, when the range of the α-particles is as low as 3 cm. they cease to liberate α-particles of observable range from carbon. The minimum energy of the α-particles required for the disintegration of carbon is larger than that required in the case of aluminium. H. N. A.

2749. Disintegration Constant of Actinium. S. Meyer. *Akad. Wiss. Wien, Ber.* 137. 2*a*. 3–4. *pp*. 235–239, 1928.

Various values have been given for the half-life period of this substance, and the author has previously found T = 14 to 16·5 years. The observations have been continued, and some of the series now cover more than 14 years, but the results can still only be regarded as approximate. In addition to observations on the disintegration of actinium, others on the growth of this substance from protoactinium have been made, from which T can be estimated. The most probable value is given as 13·4 years. [See also Abstract 758 (1919).] H. N. A.

2750. Dependence of the Photographic Action of β-Rays on their Velocity. C. D. Ellis and G. H. Aston. *Roy. Soc., Proc.* 119. *pp*. 645–650, *July* 4, 1928.

β-particles from radium B and C were employed. Gurney by measuring the charge has found how the number of electrons from such a source depends on the velocity. Ilford X-ray emulsion plates were employed, and pairs of photographs taken with different magnetic fields, so as to compare the photographic action of electrons of Hρ 2000 and 5000. It was found that to get equal densities on the plates the lower velocity photograph had to be exposed one-fifth of the time given to the other. Gurney's measurements showed that there were three times as many of the slow electrons, so that if the photographic action at Hρ 2000 is taken as unity, that at Hρ 5000 will be 0·6. The final results are shown in a table and by means of a graph. H. N. A.

HEAT.

2751. Results of New Measurements of the Conductivity for Heat of Solid Crystalline Bodies from 0° to −190° C. A. Eucken and G. Kuhn. *Zeits. f. phys. Chem.* 134. 3–4. *pp.* 193–219, *June*, 1928.

Eucken and Neumann [see Abstract 2991 (1924)] found that in the cases of bismuth and antimony there was a distinct decrease in the heat conductivity when a fine crystalline mass was substituted for a compact aggregate of large crystals. Since the electrical conductivity was not similarly affected it was concluded that the " granular size " effect might be ascribed to the non-metallic side of the above metals' properties. Lastly, they brought the phenomenon into good agreement with the Debye theory of heat conduction. The present work is an extension of this previous research and seeks to apply the hypotheses regarding the granular effect to non-metallic crystals. As an example, the main work was performed on calcspar, whilst the compact fine crystalline material of the same constitution was furnished by marble. Full experimental details are given together with tables of results. It was found that calcspar also showed the previously noted " granular effect " as regards heat conductivity. Taking the readings over a range from 0° C. to −190° C. it was found that mixed crystalline structure causes a considerable disturbance of the absolute value of the heat conductivity as also of the temperature coefficient. The influence of impurities on the conductivity for heat of crystals can be similarly expressed to the Matthiessen equation for electrical conductivity and impurity in metals. The heat conductivity of the series of alkaline halogenides shows distinct maxima where the masses of both atoms are about equal. There is a distinct parallel between the heat conductivity and the hardness in cases where the constitution of the crystals can be divided into a definite number of groups. A comparison of the observed values and those obtained from the Debye theory shows considerable divergence, indicating that further investigation is necessary. S. G. B.

2752. Study of the Wiedemann-Franz Equations. A. Eucken. *Zeits. f. phys. Chem.* 134. 3–4. *pp.* 220–229, *June*, 1928.

The results of Grüneisen and E. Goens on the electrical and thermal conductivity at low temperatures are criticised as regards their treatment and a new method of interpretation is developed. It is endeavoured to show that by means of this new evaluation the results are not in disagreement with those of the author, but can be interpreted throughout in the correct sense. It is first pointed out that the initial equation of Grüneisen and Goens is not valid. The results of these two workers must be considered in the light of the disturbance of the insulation properties by impurity and " grating " or framework deformation. The effect of high temperature on the Wiedemann-Franz number is discussed and it is shown that impurity or grating structure deformation has little effect on the Wiedemann-Franz value of a definite metal at a definite temperature.

S. G. B.

2753. Relation between Heat Transmission and Friction. A. Sellerio. *Phys. Zeits.* 29. *pp.* 398–399, *June* 15, 1928.

A reply to a criticism by T. Bosch on a previous paper [see Abstract

963 (1928)] suggesting a simple method of deduction of the formula. The author quotes his authorities for the statements made and the deductions therefrom. S. G. B.

2754. Diffusion Problem for a Solid in Contact with a Stirred Liquid. H. W. March and W. Weaver. *Phys. Rev.* 31. *pp.* 1072–1082, *June,* 1928.

A cylindrical solid of length a in a direction x and arbitrary cross-section normal to x is in contact on its plane face $x = a$ with a well-stirred liquid. The face $x = 0$ of the solid and the lateral surface are impervious to heat. The liquid extends from $x = a$ to $x = a + b$, there being no loss of heat across the face $x = a + b$. The initial temperature of the solid and liquid being given, a Volterra integral equation of the second kind with discontinuous kernel is obtained for the temperature of the liquid as a function of the time. The solution of this integral equation is obtained in terms of the roots of a transcendental equation and the roots of an infinite system of linear equations. By means of the theory of singular integral equations, it is shown that the differential equation and boundary conditions possess but one solution of required type, which solution is obtained from the integral equation. The connection of this problem with a case of material diffusion is shown, and a numerical illustration is given. The theory suggests a new method of determining directly and accurately the thermal conductivity of solids. AUTHORS.

2755. Phenomena Occurring in the Condensation of Molecular Streams on Surfaces. J. D. Cockcroft. *Roy. Soc., Proc.* 119. *pp.* 293–312, *June* 1, 1928.

Reference is first made to the work of Wood [see Abstract 1397 (1915)] and Knudsen [see Abstract 1357 (1916)]. The condensation phenomena have now been studied in three separate series of experiments: (1) Where an atomic stream of approximately constant density has been allowed to fall on a condensing surface in which a temperature gradient exists and the region of deposition observed; (2) an atomic stream of variable density falling on a condensing surface of constant temperature; (3) an investigation of the effects of different surfaces and different surface conditions. It is found that most of the phenomena can be explained by the general picture of the adsorption process put forward by Frenkel. It is shown that the true surface forces are in general marked by contaminating influences which are almost certainly gas films, and these are found to influence very considerably the critical temperature described by Wood and Knudsen (*loc. cit.*). In most experiments with molecular streams these films are not eliminated, and the experiments described show that to ensure all the atoms of the stream condensing it is sufficient to have a density of the order of four times the critical density for the surface. The boundary of the deposits is extremely sensitive to changes in stream density. H. H. Ho.

2756. Condensation Phenomena at Different Temperatures. C. F. Powell. *Roy. Soc., Proc.* 119. *pp.* 553–577, *July* 4, 1928.

An apparatus is now described whereby the supersaturation required to produce condensation on ions and on associated molecules in the presence of dust-free air, over a range − 25° to + 50° C., has been measured. The effect of air has been shown of importance not only by determining the amount of water condensed per unit volume for a given degree of supersaturation, but also by preventing the evaporation of water from the walls of the expansion chamber. By an extrapolation, the supersaturation necessary to produce cloudy condensation at temperatures up to the critical point has been estimated, and the state of steam at the cloud limit at different temperatures calculated. The importance of the results in connection with the thermodynamic theory of the steam turbine is explained. It is shown that, apart from the experimental difficulties to be met in working at higher temperatures, atmospheric temperature gives the best conditions for the cloud method of investigating atomic phenomena. H. H. Ho.

2757. Abandonment of the Temperature Scale Previously Fixed by Law. F. Henning and J. Otto. *Zeits. f. Phys.* 49. 9–10. *pp.* 742–748, 1928. *From the Reichsanstalt.*

A copy of the notification regarding the amendment of the legal temperature scale and unit of heat in accordance with the findings of the International Conference of Weights and Measures in Paris, 1927, and in agreement with the Bureau of Standards of America and the National Physical Laboratory, London. The paper gives a comparison of values over a considerable range of temperature, showing the corrections necessary in applying the new scale. In all cases the values given are within the limits of experimental error. S. G. B.

2758. Specific Heats of Some Solid Bodies at Low Temperatures. K. Clusius and P. Harteck. *Zeits. f. phys. Chem.* 134. 3–4. *pp.* 243–263, *June,* 1928.

This paper records the measurement of the specific heats of gold, zinc, gallium, zinc oxide, copper oxide, zinc sulphide, ammonium carbonate and silver chloride down to temperatures near 12° Abs. by a modified apparatus which is described in detail. The results obtained have been used for the evaluation of the integration constants of the vapour pressure equations of certain metals. [See Abstract 2769 (1928).] H. H. Ho.

2759. Specific Heats at Low Temperatures of Manganous Oxide, Manganous-Manganic Oxide and Manganese Dioxide. R. W. Millar. *Am. Chem. Soc., J.* 50. *pp.* 1875–1883, *July,* 1928.

This paper continues the work dealing with the thermodynamic properties of the oxides of metals which are important in metallurgical processes [see Abstract 1395 (1926)], and records measurements for the specific heats of manganous and manganous-manganic oxides and of manganese dioxide between 70° and 300° K. The free energies of these substances have been calculated at 298° K. by means of the third law of thermodynamics. H. H. Ho.

2760. Specific Heat and Chemical Constant of Cadmium. F. Lange and F. Simon. *Zeits. f. phys. Chem.* 134. 5–6. *pp.* 374–380, *June,* 1928.

Previous determinations of the specific heat were only made down to the temperature of liquid air; the authors have measured it at temperatures from 10° to 100° Abs., and a table is given with values from 10° to 594°, the melting point. From 10° to 13° the parameter of the Debye function Θ is nearly constant. The chemical constant calculated under the assumption that the saturated vapour is monatomic is C = + 1·57 ; from this it follows that the statistical weights are equal for the atoms in the gas and in the condensed substance. This agrees with the optical measurements and the results of the Stern-Gerlach experiment. H. N. A.

2761. State and Specific Heat of Gases at Infinite Volume. R. D. Kleeman. *Frank. Inst., J.* 205. *pp.* 691–698, *May,* 1928.

At the outset two methods are deduced for proving that matter is in the atomic state when the density is infinitely small. The abnormally large values of the specific heats of substances at infinite volume are discussed under three headings: (1) The specific heat of atoms at infinitely small concentrations as affected by the heat of evaporation being zero at T = 0; (2) the specific heat of atoms at infinitely small concentrations as affected by the instability of the condensed state at or near the absolute zero of temperature; (3) the specific heat of atoms at infinitely small concentrations as affected by their forming molecules at finite concentrations. It is calculated that the specific heat of atomic hydrogen under these circumstances between the temperatures 0° and 300° K. is greater than 266 calories. The paper concludes with a note on the changes associated with abnormally large values of the specific heat. Besides changes in the electronic configuration the changes may be associated with the emission of electromagnetic radiations. A possible explanation of cosmic radiation and its origin is given. The theory is extended to discuss the radiation of the upper atmosphere. S. G. B.

2762. Examination of the Electrical Differential Method for the Measurement of C_v in Gases. Pt. II. The Experimental Deviations from the Principle of the Calculation for C_v. Their Considerations and the Accuracy of C_v thereby Attainable. M. Trautz and O. Trautz. *Ann. d. Physik,* 86. 1. *pp.* 1–65, *June* 5, 1928.

The authors have investigated experimentally and theoretically the assumptions made when calculating C_v (with the electrical differential method) according to the formulæ given in Part I [see Abstract 2569 (1927)]. It was found that the required conditions were not fully satisfied and constant sources of error remained, but as the most desirable conditions were approached many errors were eliminated. The constant errors arise from an incomplete equality of the phenomena compared by the differential method between the two parts of the double experiment. An expression is obtained by which the errors can be determined and an experimental method set up for their determination. A general survey gives the approximate amount of the errors, heat conduction to the edges of the vessel being the greatest. In so far as one is not dealing with mixtures of gases, the errors do not exceed 0·5 %, and this degree of accuracy is attainable in the values of C_v. R. S. R.

2763. Physical Properties of Salicylaldehyde. T. S. Carswell and C. E. Pfeifer. *Am. Chem. Soc., J.* 50. *pp.* 1765–1766, *June,* 1928.

The following physical constants, determined on a highly purified sample of salicylaldehyde, differ considerably from those given in the most recent literature: boiling point under 751 mm. pressure, 196·4 to 196·5°, under 25 mm., 93°; crystallising temperature, 1·6°; density at $\frac{20^\circ}{20^\circ}$ 1·1690. T. H. P.

2764. Melting Point of Meta-Dinitrobenzene. F. McCamish and A. Salathe. *Am. Chem. Soc., J.* 50. *p.* 1785, *June*, 1928.

Though 90° is given as the melting point in the textbook and 89·7° in the International Critical Tables, the authors, using Washburn's method, employing an unsilvered half-pint thermos bottle, find 89·57° as the mean corrected value for the melting point of the recrystallised material. J. K.

2765. Development of a Method of Radiation Calorimetry, and the Heat of Fusion or of Transition of Certain Substances. L. E. Steiner and J. Johnston. *J. Phys. Chem.* 32. *pp.* 912–939, *June*, 1928.

The method described has the advantage of being rapid and accurate for the estimation of transition temperatures and generally for direct measurements in numerous cases where the alternative procedures are indirect. The disadvantages are those associated with the properties of organic compounds such as poor heat conductivity, which render difficult calorimetric measurements on them by any method. Accuracy, however, within 5 % is claimed for the process. Full experimental details are given, together with a theoretical treatment of the relation between heat content and the time-temperature curve. Data are given for the heats of fusion of phenol, benzophenone and chloracetic acid, and for the heats of transition of ammonium nitrate and mercuric iodide. H. H. Ho.

2766. Study of Moving Flames. W. Payman. *Chem. Soc., J. pp.* 1738–1740, *June*, 1928.

Descriptions are given of two pieces of apparatus, the "flame-speed camera" and the "wave-speed camera," which have been used in researches on the propagation of flame in gaseous mixtures. Both methods depend on the abrupt change of refractive index of a gas-mixture at the surface of a flame passing through it [see Abstract 2149 (1928)]. T. M. L.

2767. Free Energy and Fugacity in Gaseous Mixtures of Hydrogen and Nitrogen. A. R. Merz and C. W. Whittaker. *Am. Chem. Soc., J.* 50. *pp.* 1522–1526, *June*, 1928.

Calculation of the fugacities and free energies of hydrogen and nitrogen in their mixtures from the experimental results of Bartlett (*ibid.*, 49. p. 1955, 1927) yields values which show a maximum deviation from the Lewis and Randall assumption of a perfect solution (*Thermodynamics and the Free Energy of Chemical Substances*, 1923) not exceeding about 20 % with pressures up to 1000 atmospheres. T. H. P.

2768. Fermi-Dirac Hypothesis of Gas Degeneration and its Applications. E. S. Bieler. *Frank. Inst., J.* 206. *pp.* 65–82, *July*, 1928.

A review of the theory of Fermi and Dirac constituting a survey of the different applications of the theory and enunciating Pauli's statement on the connection between the de Broglie wave and the Fermi-Dirac principle. Pauli stated that "in any given atom there cannot be two electrons possessing the same combination of the four quantum numbers." Fermi extended this principle to the molecules in a mass of gas and thus afforded a basis for the explanation of the low-temperature properties of gases. Dirac reached the same conclusion on the basis of a similarity of expression of molecular properties and those of electrons in matrix mechanics. The applications of the theory to the electron theory of metals are enumerated: (1) The absence of a contribution of the free electrons to the specific heat of metals; (2) the approximate constancy of the paramagnetic susceptibility of the alkali metals; (3) the constancy of the ratio of thermal to electrical conductivity; (4) the Volta effect; (5) thermoelectric phenomena in metals; (6) the emission of electrons from hot bodies; (7) the existence of a sharp threshold frequency in photoelectric emission from metal surfaces; (8) the thermomagnetic and galvomagnetic effects. These and other details are fully reviewed and discussed in the paper. S. G. B.

2769. Vapour Pressure and Chemical Constants of Chlorine. P. Harteck. *Zeits. f. phys. Chem.* 134. *pp.* 21–25, *May*, 1928.

An apparatus is described by which the saturation pressure of chlorine has been measured between 2·6 and 634 mm. Hg. The boiling point and melting point were found to be −33·95°C. and −100·5° C. respectively at 760 mm. The pressure at the triple point amounted to 9·8 mm. The chemical constant of diatomic chlorine was found to be $1{\cdot}67_5\begin{cases}+0{\cdot}07\\-0{\cdot}12\end{cases}$ and differed from the value obtained from the Nernst theorem, which is about 0·3 greater. H. H. Ho.

2770. Study of Molecular Forces. A. Eucken and F. Bresler. *Zeits. f. phys. Chem.* 134. 3–4. *pp.* 230–242, *June*, 1928.

A note on the alteration of the saturation vapour density of liquids through the introduction of high pressure gases and their relationship with the van der Waals' constant $a_{1.2}$. A theoretical discussion is followed by an experimental determination of the effect in a steel bomb. By means of an interference method the saturation density of carbon bisulphide was measured after the introduction of high pressure CO_2, N_2, H_2. The values of a were calculated from the results of experiment and compared with those of other authors. It is established that the Berthelot expression for the relation between the constant a_{12}, the molecular attraction, and the van der Waals' constants a_1 and a_2 respectively for simple gases is approximately valid. S. G. B.

2771. Integrating Factor for the van der Waals-Clausius Equation as Function of Two Variables. A. Press. *Zeits. f. Phys.* 49. 3–4. *pp.* 306–310, 1928.

A theoretical note on the integrating factor as a function of two variables and the consequences thereof. The full application to Wien's law and Boltzmann's adiabatic invariant is of particular note. Theoretical throughout. S. G. B.

2772. Total Radiation from Metals. A. L. Helfgott. *Zeits. f. Phys.* 49. 7–8. *pp.* 555–586, 1928.

By an empirical argument the total radiation from metals is shown to be given by $E_m = \sigma T^4(1 - \theta^{-aT})$, where a is a characteristic constant of the material (atomic-activity constant). The validity of this equation is shown for tungsten, molybdenum, platinum, silver, nickel and other metals. The approximate values of the constant were: Ni, $1{\cdot}65 \times 10^{-4}$; Ag, $1{\cdot}20 \times 10^{-4}$; Mo, $1{\cdot}18 \times 10^{-4}$; Ta, $1{\cdot}47 \times 10^{-4}$; W, $1{\cdot}47 \times 10^{-4}$; Os, $1{\cdot}08 \times 10^{-4}$; Pt, $1{\cdot}25 \times 10^{-4}$. The Lummer equation for total radiation is contained, to the first approximation, in the new radiation law. At the absolute zero of temperature pure metals become totally reflecting, and for increasing temperatures the absorptive power for the same wavelength must approximate closer and closer to unity, until the black-body state is attained. An attempt is made to give the above radiation law a theoretical significance and two assumptions are made: (1) In every hot body there are two kinds of atoms or molecules, radiantly active or radiantly inactive; (2) the number of the active atoms N_a divided by the total number N gives a ratio $A = \frac{N_a}{N}$ (known as the "activity" degree). The inactive atoms N_i stand in the relationship $R = (1 - A) = N_i/N$. Between both kinds of atoms at a given temperature there exists a thermodynamic equilibrium given by $A/R = K = f(T)$. The member of the radiation equation ϵ^{-aT} can be explained in that the effect of a small alteration of temperature gives a corresponding alteration in the number of inactive atoms which is always proportional to the number existing already in the inactive part. The new radiation equation also shows that the radiating portion of heat radiating bodies follows the Stefan-Boltzmann law, and that this radiating portion is equal to the fraction of the active atoms. The Lummer equation, therefore, shows that with increasing temperature not only the radiation of the radiating part of the body increases as the fourth power of the temperature, but also the number of radiating particles. Wien's law is shown to be valid for the total radiation of pure metal laws concerning the maximum intensity of radiation. The atomic activity constant a has the meaning of a temperature coefficient. Its interpretation is affected by all chemical and physical processes which are in any way related to temperature. The paper is threefold : (1) the equation for total radiation of pure metals is deduced, (2) the consequences of the new law are discussed, and (3) a theoretical interpretation is applied to the equation. The paper is profusely illustrated by tables and diagrams.

S. G. B.

2773. Heat Transmission in Flowing Liquids in Tubes. L. Schiller and T. Burbach. *Phys. Zeits.* 29. *pp.* 340–342, *June*, 1928.

After a review of the work of Reynolds, Prandtl, Taylor and Karman the authors proceed to discuss the work of Nusselt. The value of σ in the Reynolds equation as later developed by Nusselt is discussed, and the problem as to whether the Nusselt equation is valid only when $\sigma = 1$ is theoretically examined. A further equation is developed as a limiting case of the Nusselt expression. This equation is in agreement with the experimentally determined values for water. S. G. B.

2774. Molecular Heat and Entropy of Hydrogen Chloride Calculated from Band Spectra Data. E. Hutchisson. *Am. Chem. Soc., J.* 50. *pp.* 1895–1900, *July*, 1928.

The calculations are based on Kemble's values for the energy levels, and the "*a priori* probabilities" or weights of the quantum states assigned by the new mechanics. A table gives the molecular heat of gaseous hydrogen chloride for temperatures from 1° K to 600° K. The curve obtained by plotting the molecular heat against temperature rises to a maximum at 12·5 K. At 0° C. the calculated molecular heat agrees very well with the single reliable experimental value, while the earlier calculations of Hicks and Mitchell give a value about 0·1 cal. mole^{-1} deg.^{-1}

too low. The entropy for the different temperatures is calculated by the method suggested by Giauque and Wiebe, that at 0° C. is found to be 44·04, using the Tetrode value of the chemical constant, and 43·72 using the Lewis value. H. N. A.

2775. Statistical Bases of Thermodynamics. A. Carrelli. *N. Cimento,* 5. *pp.* 1–14, *Jan.,* 1928. *Rivista.*

The origin of the statistical conception of entropy is due to Boltzmann, but it is shown how the bases used by Boltzmann are not satisfactory and have been modified by Bose and Fermi. The bases of the theories are illustrated by reference to the problem of the distribution of particles among spatial cells. The application of the theories is illustrated. A. Wh.

2776. Thermodynamic Characteristic for all Bodies. A. Press. *Washington Acad. Sci. J.* 18. *pp.* 297–301, *June* 4, 1928.

The treatment starts with the fundamental energy equation of thermodynamics $dQ = dU + pdv = dU + dW$. dU represents the internal energy and is a perfect differential, pdv is not. To integrate the above equation, therefore, the equation must be multiplied by a known integrating factor. This factor is $\mu = f(v, \theta)$. In order to develop the theory it is postulated that (1) the integrating factor $\mu = f(v, \theta)$ as above will be common to all bodies characterised by the energy equation above, and that (2) any value of μ so taken and a p given, a body can always be found that will enable U to be arbitrarily chosen, making U, therefore, an independent variable with respect to a given μ and p. The equation is then solved by a method of separation of the variables. It is shown that the particular integrating factor given by $pV = 1/\mu$, with $\mu = f(U)$, leads to a consideration of a new type of cycle analagous to that of Carnot. The new cycle comprises two adiabatics and two iso-U curves instead of two isothermals. S. G. B.

2777. Extension of the Einstein Gravitational Principles to Thermodynamics. T. de Donder. *Comptes Rendus,* 186. *pp.* 1599–1601, *June* 11, 1928.

In this mathematical note the author shows how the two chief laws of thermodynamics may be expressed in relativity language. § 1 considers the theorems of impulse and energy, whilst § 2 deals with the first law, and § 3 with the second law of thermodynamics. H. H. Ho.

2778. Changes that may take place in the Inter-Atomic Internal Energy according to Thermodynamics and Catalytic Action. R. D. Kleeman. *Phil. Mag.* 5. *pp.* 1191–1198, *July,* 1928.

§ 1 discusses the form of the equation of state of a perfect gas according to thermodynamics and § 2 the gas scale and thermodynamical scale of temperature. § 3 considers the change in inter-atomic internal energy on change of volume of a chemically non-interacting gas when it is shown that the kinetic energy of a molecule is not exactly proportional to T, but also depends on the volume of the gas, especially when this is large. § 4 extends the investigation to a chemically non-interacting gaseous mixture. § 5 discusses changes in internal energy that substances undergo on being brought into contact, from which it follows that the nature of matter is constantly changing. § 6 is devoted to contact catalytic action. § 7 describes the use of the equation $pv = M\xi RT$, where ξ has been determined in § 2 to be a function of v besides that of T, in determining the functional nature of the constant of mass action. H. H. Ho.

SOUND.

2779. Differential Intensity Sensitivity of the Ear for Pure Tones. R. R. Riesz. *Phys. Rev.* 31. *pp.* 867–875, *May*, 1928.

The ratio of the minimum perceptible increment in sound intensity to the total intensity, $\Delta E/E$, which is called the differential sensitivity of the ear, was measured as a function of frequency and intensity. Measurements were made over practically the entire range of frequencies and intensities for which the ear is capable of sensation. The method used was that of beating tones, this method giving the simplest transition from one intensity to another. The source of sound was a special-moving coil telephone receiver having very little distortion, actuated by alternating currents from vacuum tube oscillators. Observations were made on twelve male observers. Average curves show that at any frequency $\Delta E/E$ is practically constant for intensities greater than 10^6 times the threshold intensity; near the auditory threshold $\Delta E/E$ increases. Weber's law holds above this intensity, the value of $\Delta E/E =$ constant lying between 0·05 and 0·15 depending on the frequency. As a function of frequency $\Delta E/E$ is a minimum at about 2500 cycles per sec., the minimum being more sharply defined at low sound intensities than it is at high. This frequency corresponds to the region of greatest absolute sensitivity of the ear. Analytical expressions are given [Eqs. (2), (3), (4) and (5)] which represent $\Delta E/E$, within the error of observation, as a function of frequency and intensity. Using these equations, it is calculated that at about 1300 cycles per sec. the ear can distinguish 370 separate tones between the threshold of audition and the threshold of feeling. AUTHOR.

2780. Origin of Speech. R. A. S. Paget. *Roy. Soc., Proc.* 119. *pp.* 157–172, *May* 1, 1928.

The suggestion is made that primitive language is based upon gestures accompanied by corresponding movements of the vocal organs. It is noteworthy that in most languages the words for " little " contain vowels with a " front resonance," produced by a short space between tongue and front teeth, whereas the words for " great " involve a larger space and lower-pitched resonance. The attempt is made to devise pantomimic gestures of the tongue describing certain elementary actions, such as stroking, scraping, stabbing, shooting, etc., and noting the whispered syllables thus produced. Many such syllables are found in primitive Polynesian languages and old Japanese. E. E. F. d'A.

2781. " Mistuning " of Weighted Forks. W. R. Miles. *Journ. Sci. Instruments*, 5. *pp.* 152–154, *May*, 1928.

Weighted tuning forks in general use are so constructed that the weights cannot be adjusted with very great exactness. The question is raised whether an important error is apt to result. Photographic records are given which show the vibrations from *both prongs* when the weights have been unequally set. Variations between the settings of the two prongs as large as 22 v.d. were tried. The prongs always vibrate alike so far as rate is concerned. The " slower " prong appears to show the smaller amplitude. The change from unequal weighting, or unbalancing the fork, is shown conspicuously in the duration of the tone. Precise tuning may be done by shifting one weight. Four prongs, as arranged on a farmer's pitchfork, vibrating together, demonstrate beats and behave differently from the members of the tuning fork. AUTHOR.

2782. Theory of the Herschel-Quincke Tube. G. W. Stewart. *Phys. Rev.* 31. *pp.* 696–698. *April*, 1928.

The well-known simple explanation of the Herschel-Quincke interference tube is inadequate. In the present paper it is shown that the ratio of the transmitted to the incident acoustic energy is

$$[4(\sin(\alpha_3+\alpha_2)/2)(\cos(\alpha_3-\alpha_2)/2)]\\ \{[1-2\cos(\alpha_3+\alpha_2)+\cos(\alpha_3-\alpha_2)]^2+4\sin^2(\alpha_3+\alpha_2)\}^{-1/2},$$

where α_2 and α_3 are the phase changes over the two branches of the tube. This ratio is zero, not only when $\alpha_3-\alpha_2=(2n+1)\pi$, as formerly explained, but also when $\alpha_3+\alpha_2=2n\pi$, provided $\alpha_3-\alpha_2\neq 2n_1\pi$, where n and n_1 are independent integers. The transmission in an interference tube having branches 10·0 and 14·3 cm. in length was studied, and showed satisfactory agreement with the new theory. Practically zero transmission was found at frequencies of 1100 and 3300 d.v., and this is in accord with the simple theory of difference in path, as well as the revision here presented. But there was also serious interference at 1000, 2000, 3000 and 4000 d.v., and this fact is in accord only with the revised complete theory. AUTHOR.

2783. Demonstration of the Doppler Effect. J. Zenneck. *Phys. Zeits.* 29. *pp.* 343–344, *June* 1, 1928.

A short note on a method of demonstrating the Doppler effect with sound waves, using a loud speaker supported on a pendulum and an oscillograph. W. H. GE.

2784. Amplitude of Sound Waves in Resonators. E. G. Richardson. *Phys. Soc., Proc.* 40. *pp.* 206–218; *Disc.*, 219–220, *June*, 1928.

In continuation of previous work [see Abstract 421 (1927)] measurements are made of the acoustic impedance of the orifices of closed cylindrical resonators. By adapting the idea of impedance one formula may be obtained to suit both the pipe and the (cylindrical) Helmholtz resonators, *viz.*, $\tan kL = K/kS$, where k is $2\pi \times$ frequency $\div$ velocity, L is the length of the cylinder, S its sectional area, and K, the conductivity of the orifice, is equal to its diameter. The formula is found to agree with experiment, but discrepancy occurs with wide tubes. In a Helmholtz resonator, using a hot wire, the displacement was measured, and Helmholtz's assumption was verified that the motion was confined principally to the neck of the resonator. A double resonator was also tested; in this, the vibrations in the inner neck have greater amplitude than those in the outer neck, in spite of greater impedance in the former case. An expression is developed for the impedance of an orifice when effects due to viscosity are included. The result is substantially the same as that found by Stewart [see Abstract 2416 (1926)]. Tests of the air velocity in the orifice establish that the motion is greatest in the outer rings of the orifice, and the contrast becomes greater with increase of frequency, as in the skin effect of an alternating electric current. An annular orifice was found to have smaller impedance than a circular orifice of equal size. G. E. A.

ELECTRICITY AND MAGNETISM.

THEORY, ELECTROSTATICS AND ATMOSPHERIC ELECTRICITY.

2785. Influence of Gravitation on Electromagnetic Phenomena. E. T. Whittaker. *Nature,* 121. *pp.* 1022–1024, *June* 30, 1928. *From a Lecture delivered to the London Math. Soc.*

Gives in words the results of the lecturer's mathematical investigation [see Abstract 695 (1928)] and of Copson's work on the same lines [see Abstract 1672 (1928)]. The following points are discussed: (1) analogy between the gravitational effect and modification of the electromagnetic field by a medium of variable dielectric constant, (2) possibility of capture of a light ray by a mass point, (3) production of radiation by an electron at rest in a variable gravitational field, (4) the electromagnetic energy conception in statical and non-statical gravitational fields. W. S. S.

2786. Ampérien in the Theory of Spectra. R. Ferrier. *Comptes Rendus,* 186. *pp.* 1710–1712, *June* 18, 1928.

The general equations of electrodynamics completed by the addition of the ampérien A [see Abstract 993 (1928)] are found to possess a solution corresponding to a certain kind of photon, namely, " the rotating oscillator." The kinetic energy W and kinetic moment M of this " rotating oscillator " are shown to be related by the formula $W = 2\pi\nu|M|$, where ν is the frequency of the oscillator. When an atom emits energy $h\nu$, Bohr's theory requires a change in its kinetic momentum of amount $\frac{h}{2\pi}$. Thus the production of a " rotating oscillator " would compensate simultaneously for the variation in energy and in kinetic momentum of the atom.

W. S. S.

2787. Waves of an Electron. G. P. Thomson. *Roy. Inst., Proc. Advance Proof,* [9 *pp.*]. *Received June,* 1928. *Nature,* 122. *pp.* 279–282, *Aug.* 25, 1928.

The lecturer gives an account of his experiments on the production of electron diffraction patterns when a fine pencil of electrons of given velocity impinges on a thin sheet of crystalline material. [See also Abstract 1355 (1928).] W. S. S.

2788. Total Reflection of Electric Waves at the Interface between Two Media. H. M. Macdonald. *Roy. Soc., Proc.* 119. *pp.* 523–525, *July* 4, 1928.

It is shown that the amplitude of the electric force in the reflected waves is equal to that in the incident waves, and the amount of the change in phase at reflection is deduced. Expressions for the components of the electric force in the second medium are also derived. W. S. S.

2789. Carriers of Electricity in the Atmosphere. A. M. Tyndall. *Roy. Inst., Proc. Advance Proof,* [3 *pp.*]. *Received June,* 1928.

Interesting results have been obtained by adding to air small quantities of one of the series of normal alcohols of composition $CH_3(CH_2)_nOH$, where *n* may be zero or an integer. The molecules of these substances are known to be rod-like in shape, the length increasing with the value of *n*. They are also known to be polar, a property presumably mainly due to the OH group. The effective size of the ions in the mixture will be increased by an amount depending on the length of the molecules of the particular alcohol added. For a given vapour pressure of alcohol it was found that the reduction in mobility of an ion increases rapidly with increase of the value of *n*. The addition of the highest alcohol (amyl) used, though present as only 1 part in 300 of air, reduced the mobility of the ordinary negative air ion to about 40 % of its normal value. The effect on positive ions is not nearly so marked, though it is observable. The addition of water vapour as well as alcohol vapour to the air produces a rise in ionic mobility. If the molecules are made non-polar by removal of the OH group and making them symmetrical in structure there should be little or no effect on the mobility of the air ions. This was confirmed by the use of the hydrocarbon decane with ten carbon atoms, and therefore of length roughly twice that of amyl alcohol molecules. A. W.

2790. Influence of Geological Composition of the Ground on the Points struck by Lightning. C. Dauzère and J. Bouget. *Comptes Rendus*, 186. *pp.* 1565–1566, *June* 4, 1928.

The authors noticed that lightning flashes do not always proceed to the most prominent parts of the landscape, and the geological character of the surface has much importance. Chalky soils are usually safe, but siliceous rocks with metallic veins are dangerous. The junctions of two different strata are especially dangerous on account of erosion. The regions struck may be better conductors than surrounding parts, or the air above may be more highly ionised. Tests were applied in two parts of France where frequent electric discharges had occurred, and the second of these explanations confirmed. It is considered that if due regard is paid to this factor in choosing sites much damage due to lightning discharge may be avoided.

R. S. R.

2791. Intense Ionisation of the Air in the Regions of Frequent Lightning Discharge. C. Dauzère and J. Bouget. *Comptes Rendus*, 186. *pp.* 1744–1746, *June* 18, 1928.

Tests have been made which confirm a theory stated in an earlier paper [see preceding Abstract] that above regions where lightning discharges are frequent the ionisation of the air is unusually high. An Elster and Geitel form of apparatus was used because it is portable and has to be employed in regions difficult of access. Tests were made over regions known for the frequency of lightning discharges and at other places a short distance away but at the same height, and variations of 35 % were found in the conductivity of the air, the maxima occurring at the former places. Measurements were made as nearly as possible just before a thunderstorm. It is supposed that when the cumulo-nimbus clouds pass over these regions of high ionisation a stream of ions is drawn into the upward air current, and thus a path of less resistance is provided for the lightning discharge.

R. S. R.

2792. Electrophysical Conditions determining Lightning Surges. H. Norinder. *Frank. Inst., J.* 205. *pp.* 747–765, *June*, 1928.

Since the nature of lightning surges in a transmitting system is influenced by given electrostatic and electrodynamic conditions in the thundercloud, the author deals theoretically with the field intensity below the cloud, the distribution of the volume charge and the discharging character of the lightning. A special form of aerial system and kathode-ray oscillograph was used to record the lightning flashes. Times of only a few microseconds could be employed, since the electron jet itself acts as a relay, and it thus records only when a suitable voltage or current is applied to the deviation equipment. It was found that the lightning was always non-oscillatory, but it might have a high-frequency amplitude superimposed of only a few per cent. of the total amplitude. The growth of the discharge may be slow or extremely rapid. The former produces no surge in a transmission system, and is due to discharges within the cloud. The latter produces the surges, and is due to electric discharge between the cloud and the earth, or occasionally within the cloud. The peak of the voltage may be reached in one microsecond. Both theory and experiment show that positive surges are the more frequent. R. S. R.

DISCHARGE AND OSCILLATIONS.

2793. High-Frequency Electric Discharge. J. Taylor and W. Taylor. *Cambridge Phil. Soc., Proc.* 24. *pp.* 259–267, *April*, 1928.

Even at the highest degree of exhaustion faintly luminous discharges were observed. In a bulb of 20 cm. in diameter two types of discharge were obtained. On exciting the electrodes by high-frequency potentials luminous phenomena appeared. At first a bright luminosity filled the tube and extended down into the bulb in the form of a streamer issuing from the neck and surrounded by a diffuse luminosity filling the bulb (type A). There was practically no dark space between the glow and the wall of the bulb. On afterwards reducing the power in the oscillating circuit at a critical point the character of the discharge changed to a totally different form, and the glow in the bulb took the form of a sphere separated from the walls by a dark space of uniform thickness (type B). With this was associated darkness in the neck. In the type A discharge there is a projection of electrons down into the bulb. In the type B discharge there is no electron stream through the neck of the bulb. J. J. S.

2794. Influence of Anode Heating on the Striking of Metal Arcs. H. Alterthum and H. Ewest. *Zeits. f. tech. Phys.* 9. 6. *pp.* 221–223, 1928.

The influence of the heating of the anode was studied by means of two tungsten electrodes in a glass container, both of which could be heated by alternating currents through transformers. A direct-current supply through a potentiometer was used for the arc circuit, whilst the glass container could be either evacuated or filled with other gases at known pressures. Glow-arc characteristics were taken under various conditions of heating, and also with different gas mixtures. Anode heating makes no appreciable difference in a vacuum, but in a gas-filled vessel the striking voltage with anode heating drops to less than half the value required when the anode is cold. This is due to an increase in the mean free path of the electrons in the gas. A decrease in gas pressure with a heated anode and constant arc length has the effect of lowering the striking voltage. This decrease in striking voltage is also obtained with a decrease in arc length and an increase in electrode temperature, both electrodes being at the same temperature. If a mixture of two gases be used, it is found that an increase in the percentage of that with the lower striking voltage results in a decrease of the voltage required. [See also Abstracts 757 and 2968 (1927).] R. C. F.

2795. Rotation of the Electric Arc in a Radial Magnetic Field. M. N. Minorsky. *J. de Physique et le Radium,* 9. *pp.* 127–136, *April,* 1928.

Stolt has previously made observations of this rotation on both arcs and discharges by optical methods [see Abstract 1896 (1924)]. The present author uses an oscillograph as well as visual methods, and employs a mercury arc maintained in an annular cylindrical glass vessel. The magnetic circuit consists of an iron core which passes almost to the top of the cylindrical space inside the arc chamber, with a cylindrical yoke surrounding the latter, and is electrically excited to enable the field to be varied. The results show that when the arc is first struck a luminous band appears just above the mercury level, and after a time fills the rest of the space. When the temperature reaches its final value the discharge takes a more definite form, with a higher angle of inclination. The introduction of an inert gas increases the luminous intensity of the band, and the inclination also becomes still greater. The rotation of the arc is highly complex, an increase in the field strength variously affecting the angular rotation of the kathode spot. Increasing the discharge current increases the speed of rotation, and increasing the field strength asymptotically increases the voltage across the terminals. A fairly successful attempt is made to establish a qualitative theory to account for the phenomena, and it is shown that they are probably completely defined by the field strength, the mean free path and the electrodynamic sense of rotation; also that the rotation of the kathode spot is due to the presence of the space charge. R. C. F.

2796. Transition of the Glow Arc to the Normal Arc. H. Ewest and A. Rüttenauer. *Phys. Zeits.* 29. *pp.* 337–339, *June* 1, 1928.

The advent of the high current type of direct-current tungsten arc lamp has made possible the examination of the change from the glow arc to the normal arc. When burning normally the arc is the glow arc, but by increasing the current through the lamp the normal arc can be obtained. The change takes place with audible hissing, and is accompanied by a decrease of approximately 10 volts in the voltage across the lamp. Small anodes require a higher current density than do large ones to bring about this transformation, due to the uneven heat distribution over the large electrodes, with a consequent hot spot. Should the lamp burn as a normal arc for about four hours, complete blackening will occur. It is possible to obtain an intermediate type of arc with a small increase in current, and this is accompanied by a slight decrease in voltage and a yellowish beam of light coming from the anode. The transition from glow arc to normal arc is dependent on the gas pressure in the bulb, the change occurring at higher values of the current as the pressure is decreased. The form of the anode also affects the transition, a smooth anode requiring a much higher current than a rough one to make this change occur. Impurities in the anode lower the value of the current required for the transition, whilst the gas filling used also affects it in various ways, dependent on the gas used. Audible oscillations accompany the change to the normal arc, and these oscillations can also be shown by means of a neon tube connected across the secondary of a transformer, the primary of which is connected in series with a condenser across the tungsten arc lamp. R. C. F.

2797. Sparks of the Induction Coil between Mucronate Electrodes. C. Barus. *Nat. Acad. Sci., Proc.* 14. *pp.* 465–469, *June* 15, 1928.

The experiments were of a similar nature to those previously carried out with these electrodes, using a static electrical machine [see Abstract 1956 (1928)], and a number of observations as to the appearance of the sparks with different protrusions of the anode and kathode needles, different distances between the electrodes and different frequencies of induction coil break are recorded. H. N. A.

2798. Discharge Tube for Photometric Measurements. E. Lau. *Zeits. Instrumentenk.* 48. *pp.* 284–285, *June,* 1928. *From the Reichsanstalt.*

Previous authors have described the construction of discharge tubes using a silvered-glass tube [see Abstracts 906 (1923) and 635 (1928)]. These are not satisfactory owing to the slow change in the silver film. The present author describes a new type of discharge tube which is particularly suitable for ultra-violet work. It has an aluminium tube instead of the silvered-glass tube, and the discharge can be viewed through quartz windows at each end. Pure hydrogen is used in the tube, and both d.c. and a.c. supplies can be utilised. The intensity of the light is connected linearly with the current over a wide range. R. C. F.

2799. Mobilities of the Positive Ions formed by α-Rays in Air, Hydrogen and Helium. J. S. Rogers. *Phil. Mag.* 5. *pp.* 881–903, *May,* 1928. *Supplement.*

The mobility of positive ions has been shown to vary with the life of the ion by Erikson and Wahlin [see Abstract 198 (1923)]. The mobility of the "normal" positive ion in air was found to be 1·4 cm./sec. per volt/cm. In the present paper an account is given of an investigation in air, H, and He, of the dependence of the mobility of positive ions on their life. The method employed was a modification of the original method of Rutherford, in which an alternating potential was produced by means of a commutator. From the tables it appears that for the three gases investigated the mobility of the positive ions depends on the life of the ion, and is not a continuous function thereof, but for certain ranges of lives the mobility remains constant. The experiments indicate that whatever the ion is initially it rapidly develops into some type of cluster. Small changes of the diameter of the ion probably occur causing the ageing of the ion. The increase of the diameter must be due to the addition of neutral molecules to the ion as it ages. The increase of diameter, however, will not explain the fact shown in the tables that the mobility changes not gradually, but in definite successive steps. J. J. S.

2800. Nature of Gaseous Ions. L. B. Loeb. *Phys. Rev.* 32. *pp.* 81–96, *July,* 1928.

The nature of gaseous ions from a study of mobilities in mixtures.—After a general survey of the previous status of the question of the nature of the gaseous ion, it is concluded that for pure gases the dielectric attraction of the molecules by the charged ion can account for the order of magnitude of the mobility nearly equally well on either cluster or small ion theory. Such calculations are therefore indecisive. The measurements of mobilities in mixtures use Blanc's law as a criterion for the absence of the change of the cluster ion. The results show that Blanc's law holds in some cases and not in others. The observed nature of the mobility curves in mixtures shows three types of effects. These may be interpreted as indicating absence of clustering, labile clustering, stable clustering. The nature of the deviations in different gases indicates that where marked stable clustering occurs it is a specific effect depending on the chemical nature of the gas and the sign of charge on the ion. Such effects are superimposed on the dielectric attractions mentioned above. Erikson's results on ageing are discussed in their bearing on this work. AUTHOR.

2801. Experiments on the Diffraction of Kathode Rays. Part II. G. P. Thomson. *Roy. Soc., Proc.* 119. *pp.* 651–663, *July* 4, 1928.

Continuing the experiments described earlier [see Abstract 1355 (1928)] a discrepancy of about 6 % between observed and computed ring sizes is satisfactorily explained as due to an error in the spark-gap method of determination of the energy of the rays. Further rings for gold and platinum films are described and further confirm the de Broglie wave theory. A magnetic method is used to show that the diffracted electrons have the same velocity as those of the incident beam, to within 1 %. The possibility of resolving the different rings is discussed in relation to the number of coherent waves in the electron stream, and it is deduced from the experimental data that the wave train must be at least 50 waves in length. Some theoretical points are also dealt with. W. S. S.

2802. Diffraction of Kathode Rays by Thin Celluloid Films. A. Reid. *Roy. Soc., Proc.* 119. *pp.* 663–667, *July* 4, 1928.

More accurate determinations of the kathode ray diffraction ring sizes, on the lines of Thomson's experiments [see Abstract 1355 (1928)] were made, using celluloid films of the order 500 Å.U. thick. Besides confirming the de Broglie wave theory, the results lead to a probable structure for the celluloid film. W. S. S.

2803. Diffraction of Kathode Rays by Thin Films of Copper, Silver and Tin. R. Ironside. *Roy. Soc., Proc.* 119. *pp.* 668–672, *July* 4, 1928.

Thomson's investigation [see Abstract 1355 (1928)] is extended to films of copper, silver and tin. The diffraction rings found are of the dimensions required by the de Broglie theory. W. S. S.

2804. Are Electrons Waves? C. J. Davisson. *Frank. Inst., J.* 205. *pp.* 597–623, *May*, 1928.

An explanatory account is given of the experiments of the author and Germer on the reflection and diffraction of electrons by crystals, in particular nickel crystals. The experiments show (1) under certain conditions marked regular reflection of electrons from the surface of a single crystal; (2) absence of regular reflection from a polycrystalline surface; (3) periodic variation of the intensity of the regularly reflected beam from a single crystal with change in the bombarding potential, keeping the angle of incidence constant; and (4) occurrence of "electron diffraction beams" similar to the Lane diffraction beams for X-rays. As regards (1)–(3), the observations are in accord with the view that electrons are reflected from crystal surfaces, just as X-rays of wave-length proportional to the reciprocal of the square root of the bombarding potential. The critical directions for electron diffraction beams deviate somewhat from those for the Lane diffraction beams of the corresponding X-rays. This discrepancy is explained by regarding the crystal as a refracting medium for electrons, of refractive index different from unity. The wave mechanics interpretation of the phenomena is outlined. W. S. S.

2805. Statistical Experiments on the Motion of Electrons in Gases. R. d'E. Atkinson. *Roy. Soc., Proc.* 119. *pp.* 335–348, *June* 1, 1928.

The experiments of Townsend and others [see Abstract 186 (1927)] on the energy interchanges between molecules and free electrons are discussed with the object of reconciling the results obtained with the quantum theory of such processes. The production of ions in helium by 20-volt electrons, despite the 24·5 volt ionisation potential of the helium atom, is explained, assuming the presence of impurities and the occurrence of collisions of the second kind. The necessity to make the special assumptions of Townsend's theory is challenged. W. S. S.

2806. Secondary Electrons from Cobalt. M. N. Davis. *Nat. Acad. Sci., Proc.* 14. *pp.* 460–465, *June* 14, 1928.

One of the vacuum tubes employed had been used by Farnsworth in his work on iron, nickel and copper, and the other was very similar. The ratio of secondary to primary current was measured for each accelerating potential impressed on the primary beam of electrons striking the cobalt target; this gave the number of secondary electrons from each primary one. Curves are given showing the relation between this number and the accelerating potential with different heat treatments; these curves show certain maxima and minima. The number of secondary electrons is much larger than with any other metal which has been investigated, the maxima are more pronounced, and even the minima stand high. The first maximum occurs at a much higher voltage than with iron and nickel. The author inclines to the opinion that the cobalt maxima and all of Krefft's maxima for tungsten, except perhaps the one which developed on standing cold, are characteristic of the metals themselves. The work with tube I suggested that breaks in the curve corresponded with critical potential values for cobalt. This was not confirmed by experiments with tube II. H. N. A.

2807. Complete Photoelectric Emission from Potassium. Jessie Butterworth. *Phil. Mag.* 6. *pp.* 1–16, *July*, 1928.

Dember [see Abstract 1736 (1909)] found that a cylinder surrounding a metal plate acquired a positive charge when the plate was illuminated with ultra-violet light, and later work, by DuBridge and by Lorentz [see Abstract 1433 (1926)] showed that this was probably due to defective screening. The author investigates the effect for potassium, since alkali metals *a priori* should exhibit it to a greater degree than others. She describes her apparatus and experiments which give the ratio of negative to positive photoelectric currents as $10^{-6}/10^{-13}$, *i.e.*, 10^7 as compared with Dember's $10^{-9}/10^{-13}$, *i.e.* 10^4. Hence, if the positive photoelectric effect does occur, it is at least a thousand times smaller than the current which Dember attributed to the emission of positive ions by photoelectric action. The same apparatus was used to measure the threshold frequency or frequencies of potassium by the complete photoelectric effect in equilibrium with black-body radiation of known temperature. By repeated heatings of the potassium, it was made to form a thick opaque mirror over the bulb. The results show that potassium has at least two work functions corresponding to critical wave-lengths at 9700 and 57,000 Å.U. respectively, and the relation governing the photoelectric current is

$$\mathrm{C} = 0{\cdot}0089\mathrm{T}^{\frac{1}{2}}\left(e^{-\frac{1\cdot46\times10^{4}}{\mathrm{T}}}\right) + 5{\cdot}11 \times 10^{-7}\mathrm{T}^{\frac{1}{2}}\left(e^{-\frac{2\cdot53\times10^{3}}{\mathrm{T}}}\right),$$

the constant multiplying the larger work function being $1{\cdot}8 \times 10^{4}$ times as great as the second. This supports Richardson and Young's theory of " patches " [see Abstract 1720 (1925)], and indicates that only a small portion of the surface responds to the lower frequency, while a much larger part (perhaps the whole surface) is excited by the higher frequency. Probably the whole of a sensitised potassium surface has one characteristic work-function, but certain patches can possess one or more lower work-functions, acquiring the greater under the influence of prolonged illumination. The constant multiplying the larger work-function is itself a function of the temperature. A. S. D. M.

2808. Theory of Contact Detectors. F. Regler. *Phys. Zeits.* 29. *pp.* 429–436, *July* 1, 1928.

All important detectors in practice depend on " electrostriction " or the piezoelectric effect, Unilateral conductivity between chemically and physically pure metals in a vacuum or neutral gas is not marked, but is increased if the metal surfaces are allowed to oxidise. The detector action then depends on the crystal combination: it is known in this connection that a thermal current is generated by heating of the contact spot. The quality of a detector varies according to the direction in which the voltage is applied; if applied in the direction of the good-conducting axis, the efficiency is essentially better than in the direction of the other axes. An explanation of the oscillatory crystal is finally given. [See also following Abstract.] E. T. A. R.

2809. Crystal Detectors. P. Beck. *Phys. Zeits.* 29. *pp.* 436–437, *July* 1, 1928.

In order to study the detector action of various galena-metal combinations, the author employs an experimental arrangement by which simultaneous electrical measurements and microscopic observations are made. The following conclusions are reached: (1) The rectification is qualitatively the same, and quantitatively only little different over all smooth surfaces; (2) all edges, both of surfaces and small cracks, behave differently from surfaces, the direction being reversed in 70 % of the cases and the strength diminished; (3) two types of natural galena are found, the surfaces of which show oppositely directed rectifications; (4) with both types the current from the galena to the metal varies irregularly, while the oppositely directed current remains nearly constant [see Abstract 1969 (1928)]. E. T. A. R.

ELECTRICAL PROPERTIES AND INSTRUMENTS.

2810. Kinetic Method in the New Statistics and its Application in the Electron Theory of Conductivity. L. W. Nordheim. *Roy. Soc., Proc.* 119. *pp.* 689–698, *July* 4, 1928.

The Maxwell-Boltzmann method of classical gas theory is adapted in the new statistics, both of Einstein-Bose and Fermi-Dirac. For the variation in the distribution function f for a phase element $\Delta\Omega$ the fundamental Boltzmann equation runs:

$$0 = \frac{df}{dt} = \frac{\partial f}{\partial t} + \frac{\partial f}{\partial x}\xi + \frac{\partial f}{\partial y}\eta + \frac{\partial f}{\partial z}\zeta + \frac{\partial f}{\partial \xi}\frac{X}{m} + \frac{\partial f}{\partial \eta}\frac{Y}{m} + \frac{\partial f}{\partial \zeta}\frac{Z}{m} + a - b,$$

where a and b are respectively the number of particles thrown out of or into the element $\Delta\Omega$ by impacts in unit time, and the other symbols have their usual meanings. The classical and quantum mechanics differ in the evaluation of the collision term $a - b$, the essential divergence being that the probability of a collision-interaction of two particles depends, in the former, only on the number of particles in the initial states, in the latter, however, on the number in the final states as well. The computation of $(a - b)$ on the new statistics is carried out, and by integrating the fundamental equation the complete analogue of Boltzmann's H-theorem is obtained. For the equilibrium case with no external forces, it is shown that $f = \frac{A}{Ce^{cv^2} \mp 1}$, where $A = \frac{m^3 g}{h^3}$, v is the velocity, C and c are constants, and the negative and positive signs refer respectively to the Einstein and Dirac statistics. The kinetic method is applied to the electrons in a metal, and it is established that collisions between electrons and metallic atoms have no appreciable influence on the equilibrium distribution. [See Abstracts 1368 and 2185 (1928).] W. S. S.

2811. Thermal Agitation of Electricity in Conductors. J. B. Johnson. *Phys. Rev.* 32. *pp.* 97–109, *July*, 1928.

Statistical fluctuation of electric charge exists in all conductors, producing random variation of potential between the ends of the conductor. The effect of these fluctuations has been measured by a vacuum tube amplifier and thermocouple, and can be expressed by the formula $\bar{I}^2 = (2kT/\pi)\int_0^\infty R(\omega)|Y(\omega)|^2 d\omega$. I is the observed current in the thermocouple, k is Boltzmann's gas constant, T is the absolute temperature of the conductor, R (ω) is the real component of impedance of the conductor, $Y(\omega)$ is the transfer impedance of the amplifier, and $\omega/2\pi = f$ represents the frequency. The value of Boltzmann's constant obtained from the measurements lie near the accepted value of this constant. The technical aspects of the disturbance are discussed. In an amplifier having a range of 5000 cycles and the input resistance R the power equivalent of the effect is $\bar{V}^2/R = 0{\cdot}8 \times 10^{-16}$ watt, with corresponding power for other ranges of frequency. The least contribution of " tube noise " is equivalent to that of a resistance $R_c = 1{\cdot}5 \times 10^5 i_p/\mu$, where i_p is the space current in milliamperes and μ is the effective amplification of the tube. [See next Abstract.] AUTHOR.

2812. Thermal Agitation of Electric Charge in Conductors. H. Nyquist. *Phys. Rev.* 32. *pp.* 110–114, *July*, 1928.

The electromotive force due to thermal agitation in conductors is calculated by means of principles in thermodynamics and statistical mechanics. The results obtained agree with the results obtained experimentally. [See preceding Abstract.]

2813. Double Sign of the Hall Coefficient. V. Giambalvo. *N. Cimento,* 5. *pp.* 44–52, *Feb.,* 1928.

The ordinary electronic theory of metals does not furnish a clear explanation of the Hall phenomenon. Following on the hypothesis that the concentration of the free electrons in metals depends on the magnetic field, it appears that due to the field produced in a Hall lamina by the primary current there is generated a difference of potential which is superposed on that given by the ordinary electronic theory. These two p.d.'s have contrary signs so that the double sign of the Hall effect may be explained as due to the prevalence of one or the other of the two partial effects. J. J. S.

2814. Imperfect Metallic Contacts. G. Todesco and B. Rossi. *Accad. Lincei, Atti,* 7. *pp.* 568–573, *April* 1, 1928.

A plate and a ball, both of the same metal, will act as a current-rectifier. When they are placed in light contact and a current passed through them the surface of contact becomes altered and the sphere and ball are connected by a high-resistance conductor which does not obey Ohm's law. If the plate and ball are perfectly fixed, they rapidly lose their rectifying power and become analogous to a coherer; if they be slightly mobile with respect to one another, the connection is continually broken and the rectifying power remains. A. D.

2815. Visual Method of showing the High Temperature-Coefficient of Resistance of Metals as compared with Alloys. P. Rood. *J.O.S.A. and R.S.I.* 16. *pp.* 357–359, *May,* 1928.

Describes a convenient way of demonstrating the high temperature-coefficient of resistance of pure metals as compared with alloys. A vacuum tube with low-voltage plate source is used and the grid potential controlled by the changing voltage at the terminals of a short section of wire, as it is heated by a 6-volt storage battery. The same battery furnishes the filament current. When the circuit is closed two things are apparent; the wire heats to bright redness and the milliammeter increases its reading from near zero to about 3 milliamperes. About 30 seconds are required for this change to take place. It is possible to show that with iron wire there is only a slight change of resistance on approaching red heat. E. G.

2816. Conductance of Electrolytes. G. Jones and R. C. Josephs. *Am. Chem. Soc., J.* 50. *pp.* 1049–1092, *April,* 1928.

This paper is the first of a series on the measurement of the conductance of solutions and discusses the design of alternating-current bridges and accessories used for this purpose. The source of current recommended is an adjustable audion tube oscillator. Used with an amplifier and the telephone as detector, a sensitiveness of 1 in a million is obtainable. The use of cells of high cell constant (length divided by cross-section) is recommended, for thus the resistance to be measured will be high and polarisation and heating effects reduced. A new method of grounding, avoiding previous errors, is described. The use of oil as a thermostat liquid is advised. The equation of balance of the bridge, $R_1R_4 = R_2R_3$, is valid only if the phase angles between the voltage and current are equal in two pairs of adjacent arms. With a helical slide wire bridge, errors may occur owing to inductance in the helix. The ratio arms R_3 and R_4 should be as nearly as possible free from reactance and identical in resistance and construction. In ordinary resistance boxes the effective resistance with alternating current of audio frequency is a function of the frequency and different from the direct-current resistance. Errors arise from dielectric losses in the insulators and dissipation of energy in appended coils not in use. Specifications are given for an ideal box, and a new and improved form of bridge is described. J. J. S.

2817. Dispersion of the Conductivity and Dielectric Constants of Strong Electrolytes. P. Debye and H. Falkenhagen. *Phys. Zeits.* 29. *pp.* 401–426, *July* 1, 1928.

The authors have shown in a previous publication [see Abstract 1701 (1928)] that a dispersion of the conductivity and dielectric constants of strong electrolytes must occur, and be capable of experimental proof. The phenomenon was theoretically the consequence of a finite relaxation time of the ionic atmosphere. In the present communication the subject is developed and a general fundamental equation for the non-stationary changes in strong electrolytes is derived. General formulæ are developed for the conductivity and for the excess of the dielectric constants over the conductivity. The results are applied to special cases, and the effects of concentration on the dispersion of the conductivity, the effects of ionic mobility, the influence of the dielectric constants of the solvents and the temperature are considered. The general formulæ and the interpolation tables for calculating the limiting conductivity of any simple electrolyte are given. F. J. B.

2818. Resistivity of Thin Metallic Films. F. Joliot. *Comptes Rendus,* 186. *pp.* 1526–1528, *June* 4, 1928.

Briefly describes the results of experiments performed on kathode-sputtered platinum films on glass, the thicknesses of the films being obtained by weighing on a microbalance. At first the resistivity of the film decreases rapidly with increase in the thickness of the film, but above a film thickness of 20×10^{-7} cm. the value for the resistivity is only about four times the value normally given for platinum. Owing to the variations in the values of the resistivity of platinum films, as given by different authors, the effect of temperature on the film resistance was tried. Using a temperature range of − 185° C. to 200° C., it was found that, with a known film thickness, the resistance increased linearly with the temperature up to 75° C., and then decreased. While the phenomenon was reversible on the straight portion, it was not reversible when the maximum was passed. Thus, if the film was cooled after the maximum value of the resistance had been passed, a new linear law was obtained which was valid down to − 185° C. Several of these straight lines were obtained by alternately heating the film until on the decreasing portion of the resistance-temperature curve, and then cooling. It was then found that the temperature coefficient increased in value with a decrease in resistance caused by this heating and cooling, tending towards the normal platinum value. R. C. F.

2819. Study of the Specific Resistance of Bismuth Crystals and its Change in Strong Magnetic Fields, and Some Allied Problems. Parts I, II and III. P. Kapitza. *Roy. Soc., Proc.* 119. *pp.* 358–444, *June* 1, 1928.

In Part I the author describes a series of attempts to produce small rods, consisting of monocrystals with the perfect cleavage plane perpendicular to the length of the rod, and others with the crystallographic axis perpendicular to the length of the rod. Neither the method of Obreimow and Schubnikow, nor that of Czochralski, gave the required results, and it was found that this was due to strains produced during solidification. A method was developed by means of which such strains were avoided, and it became possible to grow rods with the orientations required, some of which were quite flexible. The specific resistance of the rods with the axis perpendicular to the cleavage plane was found to be very variable; but when they were subjected during the measurement to pressure in the direction of the axis the resistance in all cases approached $1\cdot39$ to $1\cdot14\times10^{-4}$, and remained constant with increased pressure, going back to nearly the original larger value when the pressure was removed. The effect is ascribed to minute " cracks " along the cleavage plane which are closed under pressure. The specific resistance of the other rods, parallel to the perfect cleavage plane, varied from $1\cdot07$ to $1\cdot14\times10^{-4}$; it is probable that the lower value is the correct one, the larger values being due to the fact that the trigonal axis changes its direction in certain very small parts of the crystal.

In Part II descriptions are given of the apparatus used for observing the change of specific resistance in strong magnetic fields. The method employed to obtain strong magnetic fields up to 300 kilogauss, which last for only 1/100 sec., has been previously described. The author employed a somewhat complicated switching device for periodically producing the magnetic field and at the same time sending a large current for a short time through the small bismuth rod experimented with. The magnetising current, the current through the rod, and the difference of potential between its ends were measured by means of three oscillographs.

Part III gives the measurements made of the resistance with the current perpendicular to the magnetic field and with different crystallographic orientations. In weak fields the change of resistance follows a square law and in strong fields a linear law; the latter is practically independent of the orientation of the crystal relative to the field. When the current was parallel to the lines of force a saturation effect was found. Measurements were made at 290°, 193° and 91° absolute. The results are discussed in terms of the Ganz and Sommerfeld theories of electrical conductivity. The discrepancy between theory and experiment is very large indeed; the value l of the free path of the electrons has been calculated as more than 1 cm., which seems impossibly large. The theory also makes the change of resistance proportional to the square of the field, which is only true for small fields. It is suggested that the magnetic field acts not only by deviating electrons moving freely between two collisions, but that it has a direct influence on the mechanism of collision. The original paper should be consulted for the author's suggestions as to how this takes place and why the effect should be so large in the case of bismuth.

H. N. A.

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2820. Penetration of Solid Insulators. W. Werner. *Ann. d. Physik*, 86. 1. *pp.* 95–128, *June* 5, 1928.

In solid and liquid insulators there exists penetration in the procedure of a gas discharge. The gases may occur in bubble form; as in liquids, so in the interior of a dielectric. As evidence of gaseous discharge there is: the dependence of the penetration potential on the conditions of the experiment, the dependence of the penetration potential on the thickness of the dielectric, the retardation phenomena in solid insulators, in liquid insulators the dependence on the pressure, the great increase in the penetration potential observed in liquid hydrogen and in liquid air, the fact that the penetration never occurs at the place of junction of the electrodes with the solid insulator. The author's experiments in the case of a vacuum confirm the previous observations. For the electric tenacity of solid insulators the hitherto measured tensions are much too small as far as concerns the destruction of an insulator by purely electrical means without the presence of remains of gas. If characteristic absolute values are to be obtained the presence of gas must be excluded. This absence the author has not succeeded in getting. The question is whether it is technically possible. J. J. S.

2821. Apparent Alteration in the Dielectric Constant of Technical Insulators. P. Böning. *Zeits. f. tech. Phys.* 9. 6. *pp.* 212–214, 1928.

In a previous paper [see Abstract 2490 (1928)] it was shown that in liquid and solid insulators conduction is electrolytic in character, that at bounding surfaces there is adsorption of ions and that the conduction gives rise to a system of canals filled with electrolyte. It is now shown that apparent variations in the dielectric constant of technical insulating substances under different strengths of field can be traced to adsorption of ions at the bounding surfaces of these canals. A. D.

2822. Dielectric Constants and Absorption Indices of Ethyl Alcohol for Short Electric Waves. S. Mizushima. *Imp. Acad. Tokyo, Proc.* 4. *pp.* 205–207, *May*, 1928. *In English.*

Tests with undamped electric waves of wave-length 59 cm. were made on ethyl alcohol and the dielectric constant and the adsorption index found. As the temperature was lowered, the region of anomalous dispersion shifted to longer wave-lengths. The molecular radius was calculated from these results and gave very good agreement with theory. The results form an experimental proof of Debye's dipole theory on anomalous dispersion. R. S. R.

2823. Variation with Pressure of Dielectric Constants of Liquids. L. Cagniard. *Ann. de Physique*, 9. *pp.* 460–553, *May–June*, 1928.

The author regards as untrustworthy all methods of measurement based on the use of triode valves, and has therefore used a Wheatstone bridge of four condensers, excited by a p.d. of high-frequency (w.l. 6000 m.), with a quadrant electrometer as measuring instrument. The sensitivity was increased (and can theoretically be made infinite) by a resonance on the diagonal, giving a sensitivity about 100 times greater than by the method of beats. A linear effect of pressure was observed in carbon tetrachloride, hexane and cyclohexane, and the variation of the coefficient de/dp with temperature was determined from 20° to 30°. When the molecule has a dipole in the gaseous state, these quantities are less than the values deduced theoretically from the formula of Debye, but when the molecule has no dipole they are greater. These anomalies are explained by a mutual influence of polarised molecules, comparable in a limiting case with molecular association. T. M. L.

2824. Dielectric Polarisation of Liquids. Part I. The Dielectric Constants and Densities of Solutions of the Chlorobenzenes in Benzene and in Hexane. C. P. Smyth, S. O. Morgan and J. C. Boyce. *Am. Chem. Soc., J.* 50. *pp.* 1536–1547, *June*, 1928.

In this paper a capacity bridge for the measurement of dielectric constants is described and the dielectric constants and densities of solutions of chlorobenzene and *o*-, *m*- and *p*-dichlorobenzene in benzene and in hexane are given. The polarisation and electric moments as calculated indicate that the molecules affect one another more strongly the greater their moments, the greater their concentrations and the lower the temperature. H. H. Ho.

2825. Dielectric Polarisation of Liquids. Part II. The Temperature Dependence of the Polarisation in Certain Liquid Mixtures. C. P. Smyth and S. O. Morgan. *Am. Chem. Soc., J.* 50. *pp.* 1547–1560, *June*, 1928.

In this investigation the dielectric constants of solutions of ethyl bromide, chloroform and chlorobenzene in hexane have been measured with a capacity bridge over the entire range of temperature and concentration within which the mixtures are liquid, and their densities determined by a special form of pycnometer now described. The polarisations calculated from these data have been used to estimate approximate values for the polarisation due to the shifts of atoms and groups of atoms within the molecule, to obtain accurate values for the electric moments of the molecules, and to establish the validity of the Debye equation as applied to infinitely dilute liquids. As in earlier work the molecules are found to affect one another more strongly the greater their moments and concentrations and the lower the temperature. H. H. Ho.

2826. Dielectric Polarisation of Liquids. Part III. Polarisation of the Isomers of Heptane. C. P. Smyth and W. N. Stoops. *Am. Chem. Soc., J.* 50. *pp.* 1883–1890, *July*, 1928.

This paper continues previous work [see Abstracts 287 (1925) 369 (1926) and preceding papers] and gives data for the dielectric constants, densities, refractive indices, dispersions and viscosities of the isomers of heptane and of 2, 2, 4-trimethyl pentane. The polarisations of three of the heptanes and of the octane calculated from dielectric constant and density measurements over the entire range of temperature within which the substances are liquid increase very slightly with temperature, indicating that the molecules contain no electric moments. The very small differences between the polarisations and the molar refractions extrapolated to infinite wavelength for all of the substances show the absence of a measurable moment in their molecules. It is concluded that the atoms in a saturated hydrocarbon molecule may be joined together in every possible configuration without giving rise to any measurable lack of electric symmetry, although very small differences in the rigidity of binding of the electrons are detected. The electrical symmetry of the molecules gives no evidence of a difference in the electronegativities of the various constituent radicals. H. H. Ho.

2827. Electrical Moment of Para-Azoxyanisol. J. Errera. *Phys. Zeits.* 29. *pp.* 426–429, *July* 1, 1928.

The dielectric constant of para-azoxyanisol was determined at different temperatures between 116° and 129° C., and at different frequencies. It was found that at constant temperature the dielectric constant was independent of the frequency, which was varied from 400 to 1,000,000. The optical anisotropy of para-azoxyanisol was probably due to the molecules themselves and not to the rod-shaped molecular aggregates. The electrical moment of the molecule was found to be $\mu = 2 \cdot 3 \times 10^{-18}$. F. J. B.

2828. A Series Resistance Bridge for Measuring Capacity, etc. C. L. Lyons. *Journ. Sci. Instruments*, 15. *pp.* 155–160, *May, and pp.* 188–194, *June*, 1928.

A new pattern of capacity bridge is described, which is a modified form of Wien's series resistance bridge. This is known as type 216 capacity bridge and is made by the General Radio Co., U.S.A. Each main arm contains an accurate 5000-ohm resistance and an unbalancing resistance of 5, 50 or 500 ohms can be switched into either of these arms when required. The other arms contain condensers, unknown and standard variable, and into either can be switched a resistance box of the " decade " dial pattern giving resistances from 1 to 10,000 ohms. The input circuit is supplied by a tuning fork controlled audio-frequency oscillator through a transformer and the galvanometer or " output " circuit can either contain an oscillation galvanometer or a telephone receiver, coupled by a transformer with or without a thermionic amplifier. Elaborate precautions are taken to minimise stray capacity and both transformers have earth shields. Certain portions of the apparatus are also screened by copper boxes. Care is taken in the design to secure a high degree of accuracy in a robust instrument. The calibration of the standard condensers employed is explained, and methods of using the apparatus for the following measurements are described: capacity, power factor or phase-angle of condensers, condenser losses, dielectric constant, resistance and inductance. S. R. R.

2829. Modern Photographic Electrograph. R. E. Watson. *Journ. Sci. Instruments*, 5. *pp.* 145–152, *May*, 1928.

Full details are supplied regarding the construction and action of a new installation for obtaining continuous photographic records of atmospheric electric potential. The three main parts—(1) radioactive collecting arrangement, (2) recording electrometer and (3) recording camera—are illustrated by plates. The apparatus is intended for use in Mauritius in a very humid climate, and exceptional precautions were taken to guard against leakage on account of the damp air. Tests were made of the instrument in wet misty weather with no special heating arrangements beyond those belonging to the apparatus, and the excellence of the insulating arrangements was shown. A comparison with a Kelvin water-dropper shows that the two instruments give almost identical daily means and daily ranges. The capacity of the system is small, and rapid changes of potential are well registered, while the sensitiveness is capable of variation through fairly wide limits. R. S. R.

2830. Simple Method for Measuring High Electric Potentials. H. Dember. *Phys. Zeits.* 29. *pp.* 347–348, *June* 1, 1928.

The author refers first to the increase of size when a soap bubble is electrified and obtains an expression connecting the internal pressure with the electric potential and the dimensions. He next describes a method in which a very thin Müller membrane of nickel is used stretched over a space containing air at constant pressure and temperature. It is surrounded by a larger earthed sphere having a small hole through which the movements of the membrane can be observed. The membrane is raised to various potentials by a 60-plate Toepler induction machine. Values of the deflection of the membrane are found to be, as expected from theory, proportional to the square of the potential. If the hollow outer sphere is distant and does not form a complete shield for the inner conductor then gradually a linear relation is obtained between potential and deflection as the potential rises to higher values. R. S. R.

2831. Demonstration of a Portable Electric Harmonic Analyser, showing the Measurement of Harmonics in Voltage and Current Waves. R. T. Coe. *Phys. Soc., Proc.* 40. *p.* 228, *June*, 1928.

ALTERNATING CURRENTS AND MAGNETISM.

2832. Distribution of Temperature in Alternating-Current Conductors. M. J. O. Strutt. *Phil. Mag.* 5. *pp.* 904–914, *May*, 1928. *Supplement.*

The temperature in alternating-current conductors of infinite length and circular cross-section is in this mathematical paper derived as a function of the distance from the centre when the current flows (1) along the axis, and (2) in circles round the axis. In case (1) for high frequency the highest temperature (in the centre) tends to one-half of the temperature when the same effective direct current flows through the conductor, the surrounding medium being at zero. Hence, it follows that by raising the frequency the temperature inside the conductor is lowered. In case (2) it is found that the temperature of the surrounding medium and the magnetic field outside the conductor being constant, the temperature inside increases everywhere with the frequency. J. J. S.

2833. Foucault Currents. L. Barbillion. *R.G.E.* 22. *pp.* 805–819, *May* 12, 1928.

Referring to his previously published studies on Foucault currents [see Abstract 2145 (1927)], the author discusses in this paper other cases, *viz.*, that when the axis of the inducing pole coincides with the axis of rotation of the disc, but the dimensions of the face of the poles are less than those of the disc, so that on this latter there are two regions, one directly under the pole at the exterior of the cylinder which envelops the pole. Several hypotheses are considered: the active surface of the pole is supposed first plane, then rounded, and, finally, its section is supposed circular or rectangular. Different expressions are deduced in these various cases for the power lost by Foucault currents. J. J. S.

2834. Dynamic Study of Magnetostriction. K. C. Black. *Am. Acad., Proc.* 63. 2. *pp.* 49–66, *April*, 1928.

Following Pierce's work on magnetostriction oscillators [see Abstract 2500 (1928)] ferromagnetic rods were clamped on the axis of a coil carrying d.c. and a.c., and the electrical properties of the rods were measured when the latter vibrated longitudinally in the resonance region. The rods were of stoic metal (kind of invar), nickel and stainless steel, and they had frequencies between 2300 and 3000. Their vibrations were studied optically, and the resistance and reactance of the coil were also measured. With maximum resonance, the amplitude of vibration of the rod was from 30 to 200 times as great as its length change in a constant field. The " motional " resistance and reactance of the coil change with frequency in such ways that the graph of resistance and reactance is a circle, the diameters of the circles being for stoic metal 90 ohms, for stainless steel 70 ohms, and for nickel rod 35 ohms. The amplitude of vibration of the rod has an approximate linear relation to the motional impedance of the coil. In all cases the natural frequency of the rod increased with increase of the polarising field. Some tests were also made with split nickel tubes. As sources of sound the tubes are more powerful than the rods, and the sound output may be increased by fastening discs or cans to the ends of the tube, the motional impedance being at the same time diminished.

G. E. A.

2835. Theory of Ferromagnetism. W. Heisenberg. *Zeits f. Phys.* 49. 9–10. *pp.* 619–636, 1928.

The paper deals with the nature of Weiss's intermolecular forces, and seeks to derive them from a quantum resonance phenomenon between electrons moving in different places with otherwise equivalent paths. An attempt is made to relate the intermolecular forces specifically to electric or magnetic interactions between the magnetic molecules. Equations for the magnetic moment are deduced which are identical with those of Weiss, and the theory now propounded predicts two additional factors which must exist for ferromagnetism to occur, *viz.*: (1) The space lattice must be such that each atom has at least eight neighbours; (2) the total quantum number of the electrons responsible for the magnetism must not be less than three. Iron, nickel, and cobalt satisfy both conditions, although not to the exclusion of other substances. Extension of the theory to the case of a more complicated atomic model is to be attempted. The com parison of the theory with experimental results is being carried out.

S. G. B.

2836. Evidence Obtained by X-Ray Analysis of Films of Iron in Magnetic Fields as to the Ultimate Nature of Magnetism. T. D. Yensen. *Phys. Rev.* 32. *pp.* 114–122, *July*, 1928.

The results of K. T. Compton and Trousdale [see Abstract 919 (1915)] and of A. H. Compton and Rognley [see Abstracts 566 (1918) and 535 (1921)] showed that there is no change in the crystal structure of single crystals of magnetite and hematite when placed in strong magnetic fields. In the present investigation films of electrolytic iron were analysed by X-rays to determine whether there is any change in the random orientation of the minute crystals (of the order of 150 Å.) found in these films when placed in strong magnetic fields (up to 2600 gauss). If so, the uniform circular diffraction patterns resulting from the randomly oriented crystals should, because of the preferred orientation, be changed to show greater or less density along a diameter parallel to the applied magnetic force than along the other, perpendicular to it. The circles were analysed microphotometrically and the results indicate no change in the orientation. The average of all the measurements is a ratio of the intensities along the two diameters of 1·00 ± 0·08, the variation being attributed to incidental sources arising from the developing and handling of the film. The conclusion, therefore, is that the most minute crystal aggregates in iron are not oriented in a mgnetic field and lends strength to the previous conclusion in regard to the ultimate nature of magnetism, namely, that the magneton is an atomic property. AUTHOR.

2837. Time Lag in Magnetisation. R. M. Bozorth. *Phys. Rev.* 32. *pp.* 124–132, *July,* 1928.

An investigation has been made of the time lag in magnetisation in a permalloy wire to determine whether lag can be satisfactorily accounted for as due to eddy currents alone or whether permalloy shows a marked magnetic viscosity such as has been observed by Ewing in iron wires. Eddy-current lag has been calculated approximately in a manner which takes into account the changing slope of the magnetisation curve. A comparison of the calculated and observed magnetisation-*versus*-time curves indicates that the effect is well accounted for as eddy-current lag alone. The eddy-current lag has also been calculated for an iron ring, for which the time lag has been reported recently in a number of papers by Lapp. The time lag which he observed is satisfactorily accounted for as eddy-current lag instead of as magnetic viscosity as he had supposed. AUTHOR.

2838. Magnetic Moments of the Cupric Ion. F. Birch. *J. de Physique et le Radium,* 9. *pp.* 137–141, *April,* 1928.

Various investigators, of whom only Cherbuliez worked at a large range of concentration (copper nitrate, 52·52 to 0·0068 %), ascribe a fractional number of magnetons, about 9·6, to the ion Cu^{++}. Plotting this number against the concentration of the solution, Cherbuliez found an S curve, the others a straight line relation. The author makes thermomagnetic studies of solid salts and solutions by the method of Weiss and Foëx, using $CuCl_2$ (anhydrous, with $2H_2O$, and in solution) and $CuSO_4$ anhydrous, and with 1 and $5H_2O$), and finds, in what he calls physical purity (the presence or absence of complex ions), an important factor. Allowance has also to be made for the diamagnetism of the anion, $SO_4 = -33\cdot6$, $Cl = -20\cdot1 \times 10^{-6}$ according to Pascal [see Abstract 1836 (1921)], the subjacent diamagnetism of copper (estimated at -18×10^{-6}), and in the paramagnetic CuO for the diamagnetism of atomic oxygen (-5×10^{-6}). The predominant moment seems to be 10 magnetons, but there is also a moment 9 and possibly 11. The law of Weiss $\chi(T - \theta) = C$ holds except for CuO and for the anhydrous sulphate at elevated temperatures. The extreme temperatures used were − 183 and + 535° C.

H. B.

2839. Thermomagnetic Study of Iron Sesquioxide. J. Huggett and G. Chaudron. *Comptes Rendus,* 186. *pp.* 1617–1619, *June* 11, 1928.

Malaguti described in 1863 several methods of preparing a magnetic sesquioxide. The authors find that the properties of this oxide change with the mode of preparation. They precipitate ferric nitrate with ammonia, heat the precipitate, reduce it to Fe_3O_4 in a current of hydrogen and steam, and reoxidise the compound to sesquioxide. When the reduction is effected at about 500°, the oxide is magnetic: when heated to above 600°, ordinary non-magnetic oxide is obtained. The magnetic sesquioxide loses its magnetism irreversibly when heated to 600°. When, however, the nitrate is precipitated with soda instead of ammonia, some sodium ferrite is formed and the oxide then gives reversible magnetic curves unless heated up to 800°. Impurities affect these relations. H. B.

2840. Magnetic Susceptivity of Liquids. O. Specchia. *Accad. Lincei, Atti*, 7. *pp.* 574–576, *April* 1, 1928.

A modification of Fabry's interferential method of measuring the magnetic susceptivity of liquids. A. D.

2841. Magnetic Susceptibilities of Electronic Isomers. Part II. S. S. Bhatnagar and R. N. Mathur. *Phil. Mag.* 6. *pp.* 217–223, *July*, 1928.

The molecular diamagnetic susceptibility x_m is given by $x_m = -2\cdot 85 \times 10^{10} \times 2KR^2/3$, where K is constant for any two isomeric molecules, and R is the calculated radius of the molecule. The susceptibilities were determined by Wilson's modification of Curie's balance. The factor K increases with the number of atoms in the molecule, but when groups of isomers have the same number of atoms in the molecule, K increases with the atomic number of the group. [See also Abstract 1724 (1928).] G. E. A.

2842. Experimental Method for the Determination of Ballistic Demagnetising Factors. E. Dussler. *Ann. d. Physik*, 86. 1. *pp.* 66–94, *June* 5, 1928.

The true field, acting upon an ellipsoid or a rod, is measured ballistically by the use of a solenoid of small radius placed parallel to and touching the specimen. The demagnetising factor is thus easily obtained. The method was first verified using an ellipsoid; subsequently it was employed in an examination of the variation of demagnetising factor with susceptibility for a series of cylindrical rods. The factor diminishes with diminishing susceptibility and in the limit equals $2\pi\left(\frac{d}{l}\right)^2$. When the initial susceptibility is smaller than the maximum, the factor has a greater value initially than it has for the same susceptibility in a higher field. For the same dimension-ratio and the same susceptibility the factor depends upon the material, being greater the smaller the maximum susceptibility. For medium and small susceptibilities the factor is larger for thin than for thick rods. The factor is independent of temperature. A. A. D.

2843. Sensitivity of Magnetic Variometers. H. E. McComb. *Terr. Mag.* 33. *pp.* 65–78, *June*, 1928.

Variation with ordinate in sensitivity of the horizontal-intensity variometer, San Juan Magnetic Observatory, Porto Rico, was determined in a short time by observing scale-values over a wide range of ordinate, the ordinate being changed by torsion or by an auxiliary deflector. In order to test the efficiency of a new type of vertical-intensity variometer pivot, scale-values were observed at Cheltenham Magnetic Observatory, Maryland, U.S.A., over the complete range of sensitivity of the recording magnet-system by method of deflections, of oscillations, and of weights. The values obtained from deflections were reconciled by the adoption of proper distribution-coefficients using the method of least-squares for their determination. The paper summarises and discusses briefly the experimental data obtained at the two observatories. AUTHOR.

2844. Diamagnetic Layer of the Earth's Atmosphere and its Relation to the Diurnal Variation of Terrestrial Magnetism. R. Gunn. *Phys. Rev.* 32. *pp.* 133–141, *July*, 1928.

An investigation of the motion of ions and electrons in the region of long free paths shows that the electrical conductivity in the direction of the earth's magnetic field is that predicted by simple theory. The conductivity at right angles to the magnetic field and in the direction of the applied electric field is zero, while the pseudo-conductivity at right angles to both is finite and the mechanism such that ions of both kinds are swept in the same direction. As a consequence of this situation it appears that large circulating currents in the upper atmosphere of the type assumed in present theories of the diurnal terrestrial magnetic variations [see Abstract 448 (1927)] are hardly possible. A theory of the diurnal magnetic variation is worked out which explains quantitatively the major phenomena in terms of the diamagnetic effect produced by ions spiralling about the earth's magnetic field. The diamagnetic intensity of magnetisation of the upper atmosphere in the region of long free paths is found to depend upon the total number of ions of all kinds per $cm.^3$, their mean kinetic energy and the impressed magnetic field. The maximum diurnal magnetic variation calculated as a function of latitude was found to agree in form with observation. The average maximum number of ions of all kinds per $cm.^3$ in the upper atmosphere was then computed from observed magnetic data and found to be approximately 5×10^{10}, a number not inconsistent with the ionic density inferred from data derived from radio phenomena. H. H. Ho.

RADIOGRAPHY AND ELECTROPHYSIOLOGY.

2845. Development of the Hot Kathode X-Ray Tube. *Journ. Sci. Instruments*, 5. *pp.* 170–172, *May*, 1928.

The well-known "Metallix" metal-protected X-ray tube is briefly described and illustrated. B. J. L.

2846. Viscosity Changes produced in Egg Albumen by X-Rays. J. A. V. Fairbrother. *Brit. J. of Radiology*, 1. *pp.* 121–125, *April*, 1928.

It is shown that (1) the viscosity of egg albumen is decreased to a minimum value sometimes as much as 40 % by an X-ray dose of about 211,500 e., or 176 times an erythema dose; (2) the decrease in viscosity produced is permanent, and no appreciable subsequent coagulation sets in; and (3) when irradiated egg albumen is brought to the coagulation temperature, 61° C., setting is delayed. W. V. M.

2847. Evaluation of a Pastille Dose in an Absolute Unit. W. V. Mayneord. *Brit. J. of Radiology*, 1. *pp.* 125–139, *April*, 1928.

A description is given of a standard ionisation chamber for use in X-ray intensity measurements on an absolute electrostatic unit. Sources of error are discussed, more particularly those involved in the determination of the volume of air ionised, a factor of direct importance in the setting up of a standard of the type used in this and previous investigations. A determination has been made of the number of such electrostatic units of X-radiation required to produce a change of tint of 1B in a pastille, and it is shown that the quantity is variable with the quality of radiation employed. The pastille appears to be suitable for the use of voltages in the region of

130-kV peak (or $\lambda_e = 0 \cdot 30$ Å.), but falls off in sensitiveness in either direction, and an ionisation method is always preferable. It is indicated that this variation in sensitivity is in accord with theoretical considerations.
W. V. M.

2848. Indications of the Milliameter in the Evaluation of the Heat produced by Diathermy Currents. H. Bordier. *Brit. J. of Radiology*, 1. *pp*. 170–172, *April*, 1928.

Joule's law is true for direct currents and low-frequency alternating currents, but is not applicable when the conductor is electrolytic, colloidal, or having tissue for high-frequency currents. Thus, following experiments by the author, d'Arsonval employed *progressively* decreasing concentrations of common salt and measured the rise of temperature when 500 milliamperes were passed for two minutes in each case. The heat produced reached a maximum for a certain concentration or resistance. Similar effects were observed with horse serum, drinking water, human urine and colloidal solutions of gold and platinum. The explanation is that the media have both resistance and capacity and hence two currents, one a current of conduction and the other a capacity current, the milliammeter recording both; but the one component is "wattless" and produces no heat. The calculated resistances at which the maximum should occur agree closely with those found experimentally. W. V. M.

2849. Continuous Readings of Varying Potentials by Means of Thermionic Valves. D. T. Harris. *Journ. Sci. Instruments*, 5. *pp*. 161–166, *May*, 1928.

To measure varying biological p.d.'s the instrument must have no appreciable lag and show absence of polarisation effects. Various methods of connecting triode valves to permit continuous measurement of such potential differences are described and illustrated schematically. A novel "straight line" rheostat is also described. B. J. L.

2850. Electrocapillary Penetration of Colouring Matters into the (Living) Cell. W. Ropaczewski. *Comptes Rendus*, 186. *pp*. 1758–1761, *June* 18, 1928.

Reference is made to previous work by v. Möllendorff upon the diffusion of colouring matters into gelatine blocks. The present author has measured both the rate of dispersion and the electrical charge for one hundred colouring matters, when in solutions of 1 to 1000 of pure water. This has allowed the relation of the rate of diffusion and the electrical charge to be studied with respect to both vegetable and animal cells. For the former (white flowers) it is found that acid colouring matters are able to penetrate vegetable cells, and the rate is more rapid as the rate of dispersion is greater. For animal cells (paramecium) it is found that only basic dyes are able to penetrate the cells, and this penetration is not dependent upon the rate of dispersion, as colloids appear to penetrate as easily as moleculoids.
B. J. L.

CHEMICAL PHYSICS AND ELECTROCHEMISTRY.

2851. Rôle of the Dielectric Constant, Polarisation and Dipolar Moment in Colloidal Systems, especially in Non-Aqueous Dispersions. W. Ostwald. *Kolloid Zeits.* 45. *pp.* 56–82, *May, and pp.* 114–122, *June*, 1928.

A theoretical paper not lending itself to useful abstraction. The published physical constants of about 250 organic compounds is collected in eleven tables, and the data presented are critically analysed. *Stability relationship of weak pure Organosols.*—This paper refers in the main to the experimental and theoretical work of Svedberg on platinum organosols.

J. K.

2852. Thermodynamic Theory of the Colloidal State. A. March. *Kolloid Zeits.* 45. *pp.* 97–112, *June*, 1928.

The author has previously submitted proposals [see Abstract 755 (1928)] towards establishing a general thermodynamic theory of dispersoids and the present paper is an extension of this work. § 1 considers the conditions of thermodynamic equilibrium; § 2 deals with the energy and volume of a disperse system; § 3 treats of entropy and isothermal potential; § 4 investigates the thermodynamic equilibrium of a disperse system; § 5 discusses the behaviour of thermo-stable systems for changes of pressure and pressure; § 6 gives an application of the theory to electrolytic dissociation; § 7 considers the stability of colloidal systems and the influence of the electric double layer; § 8 studies the influence of adsorption membranes on equilibria; and § 9 derives a generalisation of the equilibrium condition, and discusses the saturation concentration of colloidal solutions. Wo. Ostwald's propositions that suspensoid colloids are temperature and concentration variables, and that the degree of dispersivity increases with rising temperature and diminishing concentration, are supported.

H. H. Ho.

2853. Optical Activity and Colloidal Behaviour of Aqueous Gelatine Dispersions. E. O. Kraemer and J. R. Fanselow. *J. Phys. Chem.* 32. *pp.* 894–911, *June*, 1928.

A study has been made of the dependence of the optical activity of dilute aqueous dispersions. of de-ashed gelatine on the temperature, *p*H value, specific electrolyte, and gelatine concentration. At temperatures above 30° to 40° C., depending upon the concentration, the rotatory power is approximately independent of the *p*H, temperature, or specific electrolyte. Poorly defined minimum rotations occur at *p*H values near 1, 5 and 8·5. At lower temperatures, maximum rotations appear near *p*H 1, 5 and 8·5, the maxima and minima being very pronounced with low-gelatine concentration and low temperatures, but tending to disappear at higher concentrations. The specific influence of different electrolytes is noticable, but, except in the case of citric acid, not striking; the effects resemble lyotropic rather than valence influences. The relation between rotatory power and colloidal behaviour is found to be an intimate and detailed one. Gel formation in dilute systems is accompanied by pronounced " mutarotation " and a high specific rotation, and any agency

which prevents the characteristic increase in optical activity also prevents gel formation. An extension of the investigation showed that similar behaviour is found with other gelatine types. Pigskin gelatine exhibits highly anomalous behaviour, which characterises it as a different protein from the ordinary gelatines. A number of isolated cases are quoted from the literature in support of the view that the close association between optical activity and gel formation is a general one, and not peculiar to gelatines. The current hypotheses involving tautomeric changes between sol and gel form as an explanation of " mutarotation " are criticised; the immediate cause of the rotatory behaviour probably resides in structural features characteristic of the gel state and supermolecular in scale.
L. L. B.

2854. Equilibrium Diagram of the Copper-Rich Side of the Copper-Tin System. T. Matsuda. *Tohoku Univ., Sci. Reports,* 17. *pp.* 141–161, *March,* 1928.

The equilibrium diagram has been studied by means of thermal analysis and electrical resistance measurements. The transformation at 590° C. taking place in alloys containing 15–26·5 % of tin was found to be a eutectoid change, the eutectoid containing 26 % of tin. The existence of a transformation in the α-solid solution as observed by Isihara was not confirmed, except in the case where silver was used as lead wires. Taking into account results of previous investigators, the final diagram agrees closely with that obtained by Bauer and Vollendruck. A. A. D.

2855. Structure of Tin-Antimony Alloys. W. Broniewski and L. Sliwowski. *Comptes Rendus,* 186. *pp.* 1615–1616, *June* 11, 1928.

Chemical and physical methods of examination suggest the existence of the compounds SnSb, Sn_3Sb_2 and possibly Sn_3Sb, or of indistinct phases. The authors apply various methods, but give particulars only of the equilibrium diagram deduced from the solidification curves obtained with a Rengade apparatus. The specimens were mostly annealed for 1200 hours at 200°. Alloys containing 50 to 90 % Sb deposit, on cooling from 632° down, crystals of Sn_3Sb_2 and of solid solutions of antimony in this compound. From alloys containing 25 % Sb, a solid solution of SnSb is deposited, and crystals of this compound can be isolated thermally and chemically. H. B.

2856. Theory of the Chemical Action in the Electrical Discharge. S. C. Lind. *Science,* 67. *pp.* 565–569, *June* 8, 1928. *Paper read before the Am. Electrochem. Soc. Bridgeport, Conn., April,* 1928.

The paper briefly reviews at the outset previous observations of the slow chemical action which accompanies various types of electrical discharge in gases, and the explanatory theories: photochemical, static ions, and critical activation by kinetic ions, which have been proposed. The static-ion theory, that chemical action is the direct result of the recombination of positive and negative ions in the bosom of the gas, which so never reach the electrodes, thereby having no relation to the current, is then discussed at length, the importance of the yield factor being emphasised. All the predictions made from the α-ray results having been so thoroughly supported by the subsequent experiments in electrical discharge, it appears reasonable to assume the same general kind of mechanism in both cases. Recent work by other authors is critically examined. H. H. Ho.

2857. Chemical Interactions Corresponding to the Constant of Mass Action, being a Function of the Volume and Masses of the Constituents as well as of the Temperature and Catalytic Action. R. D. Kleeman. *Phil. Mag.* 6. *pp.* 195–203, *June*, 1928.

This paper continues previous work [see Abstracts 1329 and 2012 (1928)], and shows that the constant of mass action may be appreciably a function of T, v and M for reactions taking place under certain conditions, even when $pv = \mathrm{MRT}$ holds strictly. § 2 deals with the functional nature of the constants of mass action of gaseous mixtures reacting under certain conditions and catalytic action; § 3 considers the catalytic effect of the molecular volume of a gas on the constant of mass action of a reaction; § 4 investigates the effect of the functional form of the constant of mass action on the form of the constant of another reaction; § 5 deals with the effect of a magnetic and electric field; and § 6 with the effect of a dense substance on the constant of mass action and catalytic action. The important result is obtained that a dense substance in contact with a gaseous reaction of which it occludes to a certain extent one or more of the constituents, renders the constant of mass action a function of the volume and masses of the constituents. H. H. Ho.

2858. Characteristics of Homogeneous, Exothermic Gas Reactions. R. N. Pease and P. R. Chesebro. *Nat. Acad. Sci., Proc.* 14. *pp.* 472–475, *June* 15, 1928.

Attempts to suppress the wall reaction in the slow oxidation of methane and hydrogen in the neighbourhood of 500°. With a pyrex reaction tube, washed out with nitric acid and water, and rinsed, methane-oxygen mixtures (50: 50) react far more rapidly at 650° than if the tube is rinsed out with dilute potassium chloride solution and then several times with water. If, in the latter case, the tube is packed with broken pyrex the reaction is still slower. The conclusion is drawn that the glass packing inhibits the reaction, no positive catalytic action predominating, and that the reaction which is suppressed is homogeneous. Further experiments show that the potassium chloride treatment is not essential to the inhibitory action, clean glass fragments having a similar, though less marked, effect. Analogous evidence of inhibition by glass packing is observed in the condensation of acetylene and of ethylene.

In these reactions, since the rate in the unpacked bulb may far exceed that in the packed bulb, it is evident that some new factor comes into play, and this the authors regard as the development of reaction centres in the body of the gas. These reactions are all exothermic, and newly-formed molecules of the products possess not only the energy subsequently to be liberated as heat of reaction, but also the original heat of activation of the reacting molecules. Thus, the energy locally available is more than enough to liberate a single set of reactant molecules and probably leads to the development of what may be described as a miniature explosion wave, such waves, if unhindered, ultimately overlapping and producing a cumulative effect. T. H. P.

2859. Homogeneous Reaction between Hydrogen and Oxygen. C. H. Gibson and C. N. Hinshelwood. *Roy. Soc., Proc.* 119. *pp.* 591–606, *July* 4, 1928.

In contradistinction to the earlier investigation [see Abstract 1761 (1928)] the present paper embodies the results obtained for the study of the combination of hydrogen and oxygen between 500° and 600° C., using reaction vessels of porcelain instead of silica. It is confirmed that above 500° C. a homogeneous reaction comes into play. The order and the temperature coefficient are high. The rate of reaction is approximately proportional to the cube of the hydrogen concentration and to a power of the oxygen concentration greater than unity. Steam, helium, nitrogen and argon accelerate the reaction. It is shown that the results can be interpreted by assuming reaction chains to be propagated through the gas, and that the order of effectiveness of the various inert gases can be correlated with the diffusion coefficients. The results obtained with porcelain vessels are of exactly the same nature as those obtained in silica vessels in spite of the possible peculiar catalytic qualities of the silica in the earlier work. J. K.

2860. Energy Distribution of Complex Molecules. O. K. Rice. *Phys. Rev.* 32. *pp.* 142–149, *July*, 1928.

It is shown that, for any distribution law in which Boltzmann's law holds for the various quantum states, $d \log W/dT = (\bar{\epsilon}_W - \bar{\epsilon})kT^2$, where W is the fraction of the molecules in certain specified quantum states, $\bar{\epsilon}_W$ the average energy of the molecules in these states, $\bar{\epsilon}$ the average energy of all the molecules, T the absolute temperature, and k the gas constant. The distribution law will appear to be continuous if not viewed too closely, even though motions of the molecules are quantised, and this standpoint is adopted the fine structure being neglected. If $W_\epsilon d\epsilon$ is the fraction of molecules whose energy lies between ϵ and $\epsilon + d\epsilon$, the general rule obtaining is $\partial^2 \log W_\epsilon/\partial T \partial\epsilon = 1/kT^2$ [see also Abstract 2015 (1928)]. In a new and simple way the distribution law is found over a range of energies if the average energy of the molecules (or the energy at which W_ϵ is a maximum) is given over a range of temperatures. At a given temperature the actual distribution law is compared with a classical one which makes W_ϵ have a maximum at the same energy, and a limit is found beyond which the actual distribution law cannot depart from this particular classical law, provided the molecule is made up of a group of rotators and harmonic oscillators, and is sufficiently complex. An example is considered, which is of interest in the theory of the decomposition of azomethane [see Abstract 2016 (1928)]. H. H. Ho.

2861. Electrodynamics of Surface Catalysis. A. K. Brewer. *J. Phys. Chem.* 32. *pp.* 1006–1017, *July*, 1928.

A theoretical paper wherein is proposed a mechanism explaining the behaviour of the active centres in a catalytic surface which promote a chemical action, the proposed mechanism being based upon the experimental work on ionisation in reacting gases and the thermionic emission in the presence of various gases described in earlier papers. The equation of Richardson is referred to. The mechanism suggested is that the gas molecules upon approaching the surface are dissociated into ions by the combined electrostatic image and intrinsic forces of the catalyst. An equilibrium equation from the point of view of electrodynamics is deduced. J. K.

2862. Oxygen Electrode as a Quasi-Quantitative Instrument. W. T. Richards. *J. Phys. Chem.* 32. *pp.* 990–1005, *July*, 1928.

Reference is made to papers by Rideal and Goard [see Abstract 2633 (1924)] and others, wherein it is shown that this electrode is of practical importance. The factors of importance in the preparation of an oxygen-platinum electrode capable of giving reproducible results are given, as, for example, the electrode surface should be as large as possible, traces of chloride ion due to the initial plating must be removed, the immersed surface of the platinum electrode must be a constant, and also it is found that the type of solution in which the measurements are made has also a profound effect on the constancy of the oxygen-electrode potential. A convenient cell chain having a flowing junction and requiring only small volumes of liquid is described, these giving under suitable conditions potentials constant to a millivolt for many days. It is shown that the potential of the oxygen electrode varies quantitatively, but not thermodynamically, with the partial pressure of oxygen gas between a pressure of 0 and 1 atmosphere. It is hoped that the results of this work will prove useful in biochemical work. J. K.

2863. Preparation of the Hydrogen Electrode and Removal of a Common Source of Trouble in Connection with its Use. S. Popoff, A. H. Kunz and R. D. Snow. *J. Phys. Chem.* **32.** *pp.* **1056–1064,** *July,* **1928.**

Reference is made to the contradictory observations of earlier workers, among these being Beans and Hammett [see Abstract 1996 (1925)], who, contrary to others, were able to prepare platinised electrodes of high activity from solutions containing lead. It is shown that the hydrogen electrode attains equilibrium more quickly in a Bovie titration cell than in an open beaker, that a preliminary plating of gold on electrodes causes a more adherent coating of platinum black to be deposited, that a thinly-coated electrode is more desirable than a heavily-coated one, and that poisoning due to mercuric chloride can be removed by treatment with nitric acid or bichromate. In an investigation on oxidation potentials in which the temperature was kept constant to + 0·01°, duplicate electrodes prepared by the method given showed a maximum variation of 0·01 mV.
J. K.

2864. Application of the Quinhydrone Electrode in Electrometric Titrations. Part II. A. J. Rabinowitsch and V. A. Kargin. *Z. El. Chem.* **34.** *pp.* **311–316,** *June,* **1928.**

The discrepancy observed in the titration of weak acids between the results obtained with the hydrogen and quinhydrone electrodes [see Abstract 1584 (1927)] may be explained, as was shown by Klit [Abstract 1091 (1928)], by the influence of atmospheric carbon dioxide and removed by passing a neutral gas through the solution. Such procedure renders the use of the quinhydrone electrode more complicated and robs it of many of its advantages. Kolthoff and Bosch's view that the discrepancy is due to acid impurities of the quinhydrone [*Biochem. Z.*, 183, p. 434, 1927] is not valid, since the authors' quinhydrone was prepared by mixing alcoholic solutions of quinone and hydroquinone, and was free from oxidation products. Of the two maxima of the titration curve observed by MacInnes [see Abstract 497 (1928)], the second is caused, not by quinhydrone as acid, but by carbon dioxide. Such maxima are detectable by calculation of ordinary titration curves. By a current of a neutral gas, such as nitrogen, the first maximum reverts to its correct position and the second disappears. Introduction of a weak acid, such as alloxan, produces an effect similar to that of carbon dioxide. T. H. P.

2865. Potentiometric Titration of Vanadyl, Ferric and Chromic Ions with Standard Ceric Sulphate. N. H. Furman. *Am. Chem. Soc., J.* 50. *pp.* 1675–1680, *June*, 1928.

Solutions of 0·05 *M* ceric sulphate in dilute sulphuric acid are recommended for titrating vanadyl chloride or sulphate solutions containing free acid, alone or in the presence of large quantities of ferric and chromic salts. The iron can also de determined, and the method is suitable for the indirect determination of chromium in ferro-alloys. The vanadyl solution, which is stable for months, should be heated to 50° or 60° to facilitate the determination of the end point of constant potential, which, at ordinary temperature, may only be reached after several minutes. A burnished platinum spiral is used as indicator electrode, and a normal calomel half-cell as reference electrode. H. B.

2866. Electrometric Titration Curves of Dibasic Acids. Part I. Normal Acids. R. Gane and C. K. Ingold. *Chem. Soc., J. pp.* 1594–1600, *June*, 1928.

The paper forms a preliminary inquiry into the suitability of a method of obtaining information on the connection between molecular configuration and the external electrical field. Two methods are available, the dielectric constants of dipolar substances, and the dissociation constants of acids containing a free pole, as, for example, the second dissociation constants of dibasic acids. The electrometric titration curves for oxalic, malonic, succinic, glutaric, adipic, pimelic, suberic and azelaic acids were determined, and the values for the first and second dissociation constants were calculated. F. J. B.

2867. Application of the Fermi Statistics to the Distribution of Electrons under Fields in Metals and the Theory of Electrocapillarity. O. K. Rice. *Phys. Rev.* 31. *pp.* 1051–1059, *June*, 1928. *Paper read before the Am. Phys. Soc., March*, 1928.

It is assumed that each atom in mercury is ionised into a positive ion and an electron. Because of the crowded state of the positive ions it is supposed that they cannot move in an electric field, while, following Sommerfeld and Pauli, the electrons are assumed to act like a completely degenerate gas, following the Fermi statistics. The distribution of electrons under an electric field due to a charge on the surface of the metal is discussed, and a relation derived which gives the charge on the surface in terms of the potential difference between surface and interior. To a first approximation the charge and potential difference are proportional to each other, as if there were a condenser of constant capacity at the surface. In order to find the capacity an estimate must be made of the dielectric constant of the mercurous ions of the mercury. This is done with the aid of measurements of the refractive index of mercurous ions. The magnitude of the equivalent capacity is such that, when considered in conjunction with the diffuse layer of ions in the solution, electrocapillary curves can be explained. AUTHOR.

2868. Electroosmose and Anion Action. A. Rabinerson. *Kolloid Zeits.* 45. *pp.* 122–129, *June*, 1928.

In this investigation a talcum diaphragm made up of powder soaked in various electrolytes in solutions of varying strength is employed, and it is observed that the electroosmotic velocity is much greater than where single capillaries are employed. This is ascribed to the much greater surface of the talcum. The effect of various anions is noted. J. K.

2869. Selective Permeability of Membranes. Influence of the Mobility of the Ions on Polarisation. Miss Choucroun. *Comptes Rendus*, 186. *pp.* 1548–1551, *June* 4, 1928.

When two solutions of different concentrations are separated by a membrane, such as pig's bladder, or by a jelly, a difference of potential exists between the two solutions, which is different from that which exists between the two solutions not separated by the membranes. This difference of voltage is a measure of the polarisation of the membrane. The polarisation of the membrane was investigated for a number of different electrolytes. It was found that the following rule could be laid down as a first approximation: If two solutions of different concentrations of the same electrolyte are separated by a " charged " membrane, the membrane is only appreciably polarised if the ion having the same sign as that membrane has a mobility at least equal to or greater than that of the other ion with which it is associated. F. J. B.

2870. Calculation of Heats of Dilution according to the Debye-Hückel Theory. G. B. Bonino and V. Vaglio. *N. Cimento*, 5. *pp.* 115–126, *April*, 1928.

In the application of the Debye-Hückel theory it is usually considered valid, as a first approximation, to regard the heat of dilution of a solution indicated on the basis of this theory as proportional to the square root of the concentration. It is now shown that the theory allows of the approximate calculation of the heat of dilution as the sum of two terms, one proportional to the square root and the other to the first power of the concentration. Moreover, cryoscopic measurements show that the second of these terms is by no means negligible, even for the purpose of a first approximation. The criticism that the Debye-Hückel theory does not explain negative heats of dilution seems, therefore, justified. T. H. P.

2871. Influence of the So-called Higher Members in the Debye-Hückel Theory of Solutions of Strong Electrolytes. T. H. Gronwall, V. K. la Mer and K. Sandved. *Phys. Zeits.* 29. *pp.* 358–393, *June* 15, 1928.

For Poisson's equation, which forms the basis of the Debye-Hückel theory and determines the electrostatic potential ψ of an ion, an analytical integration process is developed which regards the complete static expression of the electric density as a function of ψ, instead of replacing the density by its first linear function in ψ, as is done in the Debye-Hückel approximate calculation. From this, the free energy and also the activity coefficients are obtained in the form of infinite series which proceed according to powers of $1/D$, where D is the dielectric constant. With very small concentrations asymptotic expressions are obtained, so that Debye's limiting law holds generally, and not merely on the basis of the Debye approximation. For the symmetrical case (ions in pairs of equal valency) the infinite series referred to above are investigated analytically as far as the term in $1/D^5$, and their values tabulated. Comparison of the formulæ with the experimental data exhibits good agreement, even in cases of small ionic diameters, in which Debye's approximation fails. T. H. P.

2872. Electrochemistry of Colloids. Part I. A Few Electrochemical Properties of Colloidal Silicic Acid. A. J. Rabinowitsch and E. Laskin. *Zeits. f. phys. Chem.* 134. 5–6. *pp.* 387–405, *June*, 1928.

This research has been undertaken in order to settle upon which of the two theories the electrical charge of colloidal particles is to be traced, namely, whether on the adsorption of ions from the surrounding solution, or from the electrolytic dissociation of the complex colloidal electrolyte. Data is given for the preparation of pure SiO_2-sol and the conductivity and potentiometric titration curves of this sol with alkali are studied respectively. The results of dilution of SiO_2-sol are also experimentally studied and interpreted, and it would seem as if on dilution the colloidal solution turns into a true solution. An explanation offered to explain this and the increase of the dissociation constant with dilution is that the inner SiO_2 molecules of the colloidal particle become hydrolysed. J. K.

2873. Electronic Theory of Valency. Part VI. The Molecular Structure of Strong and Weak Electrolytes. (b) Reversible Ionisation. T. M. Lowry. *Phil. Mag.* 6. *pp.* 50–63, *July*, 1928.

Deals with cases in which the ionisation of an electrolyte is reversible instead of complete. Compounds of this type behave as " weak electrolytes " unless the bond between the radicles is too weak to hinder the ionisation of the molecule. Such electrolytes are found amongst acids and bases, pseudo-electrolytes (such as the diazocyanides and methyl phenyl acridol), coordinated salts, and a few simple metallic salts, such as mercuric chloride, whose covalent molecules can be formed from the ions. A typical property of " weak " electrolytes is that the opposite charges of the ions can be neutralised without violating the octet rule, a real bond being produced. In considering weak acids it is shown that it can be considered that in the case of phenol the — OH radicle is held together by a real bond as in the alcohols; sodium phenate $C_6H_5 . O^-Na^+$ contains ready-made ions, and splits up into $C_6H_4O^- + Na^+$, while $C_6H_5 . O . H$ could only give ions by the rupture of the hydrogen-oxygen bond. When a dynamic model is used it seems probable that hydrogen is covalent in all its compounds, and that a naked proton H^+ does not exist, except as a transient product in a vacuum tube, or the like. The bivalency of hydrogen helps to explain the fact that polymerisation of liquid water is not accompanied by ionisation. H. N. A.

2874. Activity Coefficients of Ions in Aqueous Solutions of Non-Electrolytes. J. N. Brönsted and J. W. Williams. *Am. Chem. Soc., J.* 50. *pp.* 1338–1343, *May*, 1928.

The experiments described were made with the object of studying the variation of the activity coefficient of a saturating salt with change in the dielectric constant of the solvent, this change being effected by addition of ether or of varying amounts of sugar to pure water. Determinations of the change produced in the solubility of two complex cobaltammine salts of different valency types, use being made of the same solvent salt, sodium chloride, lead to results which completely confirm the validity of the Debye-Hückel limiting law with respect to a variation of 15 % in the dielectric constant, due allowance being made for the accuracy attainable for the slopes of the curves connecting the logarithm of the solubility ratio with the square root of the ionic strength and for the paucity of the available dielectric constant data. T. H. P.

2875. Electrolytic Preparation of the Borides of Calcium, Strontium and Barium. L. Andrieux. *Comptes Rendus*, 186. *pp.* 1537–1539, *June*, 1928.

Three borides, CaB_6, SrB_6, BaB_6, were prepared by the electrolysis of mixtures of boric acid, the carbonate or oxide, and the fluoride of the metal of which the borate was to be obtained. The electrolysis was carried out at a temperature of 1000° C. in a carbon crucible, which served as the kathode, and a carbon rod formed the anode. The crucible was broken away from its contents after the experiment. The borates and fluorides remaining unchanged were dissolved by boiling in hydrochloric acid, and the borides were separated from the insoluble fragments of the crucible by levigation and sifting. The three borides have slightly different colours, calcium boride is black, strontium boride is black with a violet tinge, and barium boride is a greenish-black. F. J. B.

2876. Preparation and Properties of Cerium Borate. L. Andrieux. *Comptes Rendus*, 186. *pp.* 1736–1738, *June* 18, 1928.

Continuing an investigation on the borates of the rarer metals, the author has now investigated the conditions for the most satisfactory preparation of cerium borate. It was found that cerium oxide dissolved in anhydrous boric acid had a very high melting point, and was not miscible with an excess of boric anhydride. The most satisfactory results were obtained from an electrolyte containing borate and fluoride of lithium, together with boric anhydride. A number of similar mixtures were electrolysed and in all cases the same borate of cerium was obtained, CeB_6. Cerium borate forms violet-blue crystals. It is not attacked by hydrochloric or hydrofluoric acids, but is attacked by concentrated sulphuric acid with evolution of SO_2. Dilute and concentrated nitric acid attack it rapidly. It burns with difficulty in air, but can be oxidised readily by peroxide of lead. It is not attacked by alkaline solutions, but is decomposed by fusion with sodium or potassium hydrate and by carbonates and bisulphates of the alkali metals. F. J. B.

2877. Electrochemical Action of Inhibitors in the Acid Solution of Iron and Steel. E. L. Chappell, B. E. Roetheli and B. Y. McCarthy. *Indust. and Engin. Chem.* 20. *pp.* 582–587, *June*, 1928.

It has been found that the addition of certain materials to the acid bath for the pickling of steel and iron greatly decreased the rate of attack on the clean steel, but permitted a fairly rapid solution of the oxide scale. The effect of inhibitors was studied in detail by measuring the rate of evolution of hydrogen, and by measuring the kathode potential of iron and steel electrodes. It was found that inhibitors had a very slight effect upon the anode potential, but a very pronounced effect upon the hydrogen overvoltage. From curves given it was shown that the reduction in rate of hydrogen evolution by the action of an inhibitor could be predicted from a knowledge of the solution potential of the metal. Data given in the paper include quantitative relationships between inhibitor concentration, temperature, hydrogen evolution, and hydrogen overvoltage. The inhibitor used for the work was quinoline ethiodide, but the results are generally applicable to other inhibitors. The mechanism of the inhibitive action is possibly due to the formation of a blanketing layer of discharged inhibitor substances adsorbed on the kathode areas. F. J. B.

2878. Electrochemical Behaviour of Silicate Glasses. Part IV. Solid Electrolytic Deposits. M. J. Mulligan, J. B. Ferguson and J. W. Rebbeck. *J. Phys. Chem.* 32. *pp.* 843–851, *June*, 1928.

The electrolysis of a tube of soda-lime glass with mercury as the anode for a long time and then with the mercury as the kathode for a short time, resulted in the tube becoming brownish in colour. Microscopic examination showed that the colour was due to the formation of a brownish deposit in the glass near the mercury-glass interface. It was found that solid electrolytic deposits may be formed in glass near the surface. The deposits observed consisted mainly of silicon or silver, depending on the materials used in the experiments. The important factor in the formation of the deposits seems to be the puncturing of the anode glass layers. The cause of the puncturing is not clear, but it seemed to occur when rapidly moving ions like silver or sodium reach the anode layers. The dielectric strength of the anode layers was shown to be dependent on the nature of the ions which reach them, and was not an intrinsic property of the layers.

F. J. B.

2879. Effect of Superposed Alternating Current on the Deposition of Zinc-Nickel Alloys. H. C. Cocks. *Faraday Soc., Trans.* 24. *pp.* 348–358, *June*, 1928.

Results are given of experiments showing the effect of a superposed alternating current in the case where zinc, nickel and hydrogen are discharged simultaneously from an acid sulphate electrolyte. The variation in the composition of the alloy and the average deposition potential with the direct-current density and with the ratio of alternating to direct current is shown. With direct current alone, a large increase occurs in the current efficiency for hydrogen at the " critical current density " of about 0·015 amp. per sq. cm., and it appears that, as the current density is raised, the reaction-resistance to nickel deposition is increased and evolution of hydrogen becomes greater. As the current density is increased still more, the hydrogen overvoltage rises and the deposition of zinc is proportionately increased until it becomes the main process. An explanation is advanced of the influence of superposed alternating current on the deposition of the alloy, this being based on the known depolarising effect of such superposed current on irreversible electrode processes when its strength relative to that of the direct current is such that reverse current flows, and on a certain assumption regarding the net result of the periodic increases of current density above that of the direct-current component. This assumption is primarily made *ad hoc* in respect of the phenomena considered, but it may possibly apply to other cases in which there is a sudden change in the electrode process with a small change in current density. T. H. P.

2880. Methods of Current Density-Voltage Measurements. A. Dadieu. *Z. El. Chem.* 34. *pp.* 301–305, *June*, 1928.

The present work investigates the anomalous current density-voltage curves resulting upon the electrolysis of metallic salts in non-aqueous solutions. It is shown that where electrolysis leads to these curves, an electrolysis in an inverted direction, as, for example, by the application of slowly diminishing voltages, can be of advantage. It is shown that this method is permissible by carrying out comparable measurements with a few solutions of various conductivity. J. K.